FIR-Specific Inputs to the ISS Hardware Interface Control Document

Fluids and Combustion Facility Fluids Integrated Rack (FIR)

Inputs to Support FCF PDR
October 20, 2000

AUTHORIZED by CM when under FORMAL Configuration Control	
Date	**Signature**
10/30/00	*/s/ Robert H. Van Niel*

Prepared For:
National Aeronautics and Space Administration
John H. Glenn Research Center
Microgravity Science Division
Cleveland, Ohio 44135

Prepared By:
Federal Data Corporation
Under Contract NAS3-99155
2001 Aerospace Parkway
Brook Park, Ohio 44142

NOTICE

The following ICD is an International Space Station (ISS)-controlled document. The FIR-specific information contained in it has been provided by the FCF team at Federal Data Corporation (FDC) to Teledyne Brown Engineering (TBE) for use in preparation of the document. The ICD is in preliminary form for this PDR. FDC will also provide updates to the FIR-specific information at the appropriate time to support FIR CDR, at which time the ICD is expected to be baselined.

FIR-SPECIFIC INPUTS TO THE INTERNATIONAL SPACE STATION PROGRAM HARDWARE INTERFACE CONTROL DOCUMENT FOR THE FLUIDS AND COMBUSTION FACILITY FLUIDS INTEGRATED RACK (FIR)

Prepared By: */s/ Nancy Benko* **Date:** *10/24/00*
Nancy Benko
FCF Utilization/Systems Engineer
Analex Corporation

Approved By: */s/ Joel Knapp* **Date:** *10/24/00*
Joel Knapp
FCF Utilization and Integration Lead
Analex Corporation

Approved By: */s/ Will Quinn* **Date:** *10/24/00*
Will Quinn
Product Assurance Manager
Hernandez Engineering Inc.

Concurred By: */s/ Andrew M. Peddie* **Date:** *10/24/00*
Andrew M. Peddie
FCF Deputy Director
Federal Data Corporation

Concurred By: */s/ Christopher J. Pestak* **Date:** *10/24/00*
Christopher J. Pestak
FCF Director
Analex Corporation

Fluids and Combustion Facility (FCF) Fluids Integrated Rack (FIR) Hardware Interface Control Document

International Space Station Program

October 20, 2000

Preliminary

TYPE 1 – NASA APPROVAL PENDING

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas
Contract No. NAS15–10000 (PA16)

REV.	DESCRIPTION	PUB. DATE
	INITIAL RELEASE (Reference per SSCD ______, EFF _____)	TBD

INTERNATIONAL SPACE STATION PROGRAM

FLUIDS AND COMBUSTION FACILITY (FCF) FLUIDS INTEGRATED RACK (FIR)
HARDWARE INTERFACE CONTROL DOCUMENT

PREFACE

This Interface Control Document (ICD) is the exclusive document used jointly by the National Aeronautics and Space Administration (NASA), and the Fluids and Combustion Facility (FCF) Fluids Integrated Rack (FIR) payload developer to identify and establish the pressurized payload physical / functional interfaces. This document contains the design implementation of the interface requirements in the Pressurized Payloads Interface Requirements Document (IRD), SSP 57000. Both sides of the interface are described and include mechanical, structural, electrical, avionic, and functional interfaces. The interfaces outlined in this document are mandatory and may not be violated unless specifically agreed upon by the Payloads Control Board (PCB). This document is under the control of the Payloads Control Board, and changes or revisions will be approved by the PCB.

APPROVED BY: ______________________________ ______________

Richard W. Nygren — Date
Manager, Space Station Payload Office
NASA/JSC/OZ

APPROVED BY: ______________________________ ______________

Robert Zurawski — Date
Manager, FCF Project Office
NASA/GRC

INTERNATIONAL SPACE STATION PROGRAM

FLUIDS AND COMBUSTION FACILITY (FCF) FLUIDS INTEGRATED RACK (FIR) HARDWARE INTERFACE CONTROL DOCUMENT

CONCURRENCE

PREPARED BY:	CRAIG SPEASE	TBE/OZ3
	PRINT NAME	ORGN
	SIGNATURE	DATE
CHECKED BY:	MICHAEL A. SOUTULLO	TBE/OZ3
	PRINT NAME	ORGN
	SIGNATURE	DATE
SUPERVISED BY (BOEING):	WADE GEIGER	BOEING/OZ3
	PRINT NAME	ORGN
	SIGNATURE	DATE
SUPERVISED BY (BOEING):	MO SAIIDI	BOEING/OZ3
	PRINT NAME	ORGN
	SIGNATURE	DATE
CONCURRENCE (NASA):	MICHAEL J. HORKACHUCK	NASA/OZ3
	PRINT NAME	ORGN
	SIGNATURE	DATE
DQA:	DAVID M. HENDERSON	BOEING/OZ3
	PRINT NAME	ORGN
	SIGNATURE	DATE

INTERNATIONAL SPACE STATION PROGRAM

FLUIDS AND COMBUSTION FACILITY (FCF) FLUIDS INTEGRATED RACK (FIR) HARDWARE INTERFACE CONTROL DOCUMENT

CONCURRENCE (Continued)

SUPERVISED BY (FDC):	NANCY BENKO	ANALEX/FCF
	PRINT NAME	ORGN
	SIGNATURE	DATE
SUPERVISED BY (NASA/GRC):	MARSHA NALL	NASA/FCF
	PRINT NAME	ORGN
	SIGNATURE	DATE

INTERNATIONAL SPACE STATION PROGRAM

FLUIDS AND COMBUSTION FACILITY (FCF) FLUIDS INTEGRATED RACK (FIR) HARDWARE INTERFACE CONTROL DOCUMENT

LIST OF CHANGES

All changes to paragraphs, tables, and figures in this document are shown below:

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
			TABLE(S)
			FIGURE(S)
			APPENDIX(ES)
			ADDENDA

TABLE OF CONTENTS

PARAGRAPH		PAGE
1.0	INTRODUCTION	1 – 1
1.1	PURPOSE	1 – 1
1.2	SCOPE	1 – 1
1.3	USE	1 – 1
1.4	PAYLOAD DESCRIPTION	1 – 2
1.4.1	PAYLOAD FUNCTION	1 – 5
2.0	DOCUMENTATION	2 – 1
2.1	APPLICABLE DOCUMENTS	2 – 1
2.2	UNIQUE ICD APPLICABLE DOCUMENTS	2 – 2
3.0	PAYLOAD INTERFACE	3 – 1
3.1	STRUCTURAL/MECHANICAL	3 – 1
3.1.1	RACK ATTACHMENT INTERFACES	3 – 1
3.1.1.1	GSE INTERFACES	3 – 1
3.1.1.2	MPLM INTERFACES	3 – 4
3.1.1.3	ISS INTERFACES	3 – 5
3.1.1.3.1	RACK TO RACK UMBILICAL DESIGN (TBD #5)	3 – 9
3.1.2	CONNECTOR INTERFACES	3 – 9
3.2	ELECTRICAL POWER INTERFACES	3 – 12
3.2.1	CONNECTORS	3 – 12
3.2.1.1	UTILITY INTERFACE PANEL	3 – 12
3.2.1.2	UTILITY OUTLET PANEL	3 – 14
3.2.2	ELECTROMAGNETIC COMPATIBILITY	3 – 14
3.2.2.1	BONDING	3 – 14
3.2.2.2	ARIS ISPR BONDING	3 – 17
3.2.3	POWER QUALITY	3 – 17
3.2.4	POWER HANDLING CAPABILITY	3 – 18
3.2.5	IMPEDANCE LIMITS	3 – 19
3.2.5.1	LOAD IMPEDANCE LIMITS	3 – 19
3.2.5.2	SOURCE IMPEDANCE LIMITS	3 – 20
3.2.6	REMOTE POWER CONTROLLER OVERLOAD LIMITS	3 – 23
3.2.7	ELECTRICAL POWER CONSUMING EQUIPMENT (EPCE) INTERFACE WITH THE UIP OR UOP	3 – 26
3.3	COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS	3 – 30
3.3.1	GENERAL REQUIREMENTS	3 – 30
3.3.2	STANDARD PAYLOAD 1553B LOW RATE DATA LINK	3 – 31
3.3.2.1	ELECTRICAL INTERFACE	3 – 31
3.3.2.2	CONNECTORS	3 – 31
3.3.3	MEDIUM RATE DATA LINK (MRDL)	3 – 34
3.3.3.1	CONNECTORS	3 – 34

TABLE OF CONTENTS (Continued)

PARAGRAPH		PAGE
3.3.3.2	ELECTRICAL INTERFACE	3 – 37
3.3.4	HIGH RATE DATA LINK (HRDL)	3 – 38
3.3.4.1	CONNECTOR	3 – 38
3.3.4.2	FIBER OPTIC SIGNAL CHARACTERISTICS	3 – 38
3.3.5	FDS / MAINTENANCE (POWER) SWITCH INTERFACE	3 – 38
3.3.5.1	CONNECTOR	3 – 38
3.3.5.2	SMOKE SENSOR CIRCUIT CHARACTERISTICS	3 – 41
3.3.5.3	RACK MAINTENANCE (POWER) SWITCH CIRCUIT CHARACTERISTICS	3 – 43
3.4	PAYLOAD VIDEO INTERFACE REQUIREMENTS	3 – 44
3.4.1	NTSC FIBER OPTIC VIDEO	3 – 44
3.4.1.1	PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS	3 – 44
3.4.1.2	PFM NTSC OPTICAL CONNECTOR	3 – 44
3.4.2	NTSC ELECTRICAL VIDEO INTERFACES	3 – 46
3.5	THERMAL CONTROL INTERFACE REQUIREMENTS	3 – 46
3.5.1	INTERNAL THERMAL CONTROL SYSTEM (ITCS) INTERFACE REQUIREMENTS	3 – 46
3.5.1.1	CONNECTOR	3 – 46
3.5.1.2	ITCS COOLANT FLOW RATE AND PRESSURE DROP	3 – 46
3.5.1.3	COOLANT SUPPLY TEMPERATURE	3 – 50
3.5.1.4	DELETED	3 – 50
3.5.1.5	SIMULTANEOUS COOLING	3 – 50
3.5.1.6	INTEGRATED RACK COOLANT QUANTITY	3 – 50
3.5.1.7	INTEGRATED RACK ALLOWABLE AIR INCLUSION	3 – 50
3.5.1.8	CABIN AIR HEAT LEAK	3 – 50
3.5.1.9	CABIN AIR COOLING	3 – 51
3.6	VACUUM SYSTEM REQUIREMENTS	3 – 51
3.6.1	VACUUM EXHAUST SYSTEM (VES) / WASTE GAS SYSTEM (WGS)	3 – 51
3.6.1.1	ACCEPTABLE EXHAUST GASES	3 – 51
3.6.1.2	INCOMPATIBLE GASES	3 – 53
3.6.2	VACUUM RESOURCE SYSTEM (VRS) / VACUUM VENT SYSTEM (VVS)	3 – 53
3.6.2.1	ACCEPTABLE GASES	3 – 53
3.7	PRESSURIZED GASES INTERFACE REQUIREMENTS	3 – 53
3.8	PAYLOAD SUPPORT SERVICES INTERFACES REQUIREMENTS	3 – 56
3.8.1	POTABLE WATER INTERFACE	3 – 56
3.8.2	FLUID SYSTEM SERVICER	3 – 56
3.9	ENVIRONMENTAL INTERFACES	3 – 56

TABLE OF CONTENTS (Continued)

PARAGRAPH		PAGE
3.9.1	MICROGRAVITY	3 – 56
3.9.1.1	QUASI–STEADY REQUIREMENTS	3 – 56
3.9.1.2	VIBRATORY REQUIREMENTS	3 – 57
3.9.1.3	TRANSIENT REQUIREMENTS	3 – 57
3.9.2	ACOUSTICS	3 – 58
3.9.2.1	CONTINUOUS NOISE	3 – 58
3.9.2.2	INTERMITTENT NOISE	3 – 58
3.9.3	HUMIDITY INTERFACE	3 – 59
3.9.4	ACTIVE AIR EXCHANGE	3 – 59
4.0	APPLICABILITY MATRIX	4 – 1
4.1	PURPOSE	4 – 1
4.2	ORGANIZATION	4 – 1
5.0	EXCEPTIONS, DEVIATIONS AND WAIVERS	5 – 1
5.1	EXCEPTIONS TABLE	5 – 1

APPENDIX

A	ABBREVIATIONS AND ACRONYMS	A – 1
B	GLOSSARY OF TERMS	B – 1
C	EXCEPTIONS AND “APPLICABLE WITH NOTES”	C – 1
D	EXCEPTIONS AND OPEN ITEMS	D – 1

TABLES

TABLE		PAGE
3.1.1.2–1	FIR MASS AND CENTER OF GRAVITY (CG)	3 – 5
3.1.2–1	ISS SYSTEM SERVICES CONNECTOR PART NUMBERS	3 – 11
3.2.2.1–1	MODULE BONDING INTERFACES	3 – 17
3.2.4–1	ISPR LOCATIONS WITH SPECIFIC EPS CHARACTERISTICS	3 – 18
3.2.6–1	DETAILED UPSTREAM PROTECTION CHARACTERISTICS	3 – 26
3.2.7–1	FIR POWER CHARACTERISTICS	3 – 27
3.3.2.1–1	FIR LRDL ELECTRICAL CHARACTERISTICS	3 – 31
3.3.3.2–1	FIR MRDL WIRING STUB LENGTH	3 – 37
3.3.5.2–1	SMOKE DETECTION SUPPORT FUNCTIONAL CHARACTERISTICS	3 – 42
3.5.1.2–1	ITCS SELECTABLE COOLANT FLOW RATES	3 – 46
3.5.1.7–1	INTEGRATED RACK AIR INCLUSION	3 – 50
3.5.1.8–1	CABIN AIR SENSIBLE HEAT LOAD	3 – 50
3.5.1.8–2	CABIN AIR LATENT HEAT LOAD	3 – 51
3.5.1.9–1	AIR HEAT LOAD	3 – 51
3.6.1.1–1	FIR VENTED GASES	3 – 51
3.6.1.2–1	INCOMPATIBLE GASES	3 – 53
3.8.2–1	FSS USAGE	3 – 56
3.9.1.1–1	QUASI–STEADY DISTURBANCE	3 – 56
3.9.1.3–1	FIR TRANSIENT DISTURBANCES	3 – 57
3.9.2.1–1	CONTINUOUS NOISE	3 – 58
3.9.2.2–1	INTERMITTENT NOISE LIMITS	3 – 59
4.2–1	APPLICABILITY MATRIX	4 – 2
5.1–1	OPEN EXCEPTIONS	5 – 1
D–1	TO BE DETERMINED ITEMS	D – 1

FIGURES

FIGURE		PAGE
1.3–1	PAYLOAD INTERFACE REQUIREMENTS AND CONTROL PROCESS	1 – 2
1.4–1	FLUIDS AND COMBUSTION FACILITY	1 – 3
1.4–2	FLUIDS INTEGRATED RACK	1 – 5
3.1.1.1–1	FIR GROUND OPERATIONS RACK PROTRUSIONS	3 – 2
3.1.1.2–1	MPLM RACK RESTRICTIONS	3 – 4
3.1.1.3–1	RACK DOOR PROTRUSION ENVELOPE	3 – 6
3.1.1.3–2	PFE ACCESS PORT, RACK MAINTENANCE SWITCH, SMOKE INDICATOR LED, AND C&W LABEL LOCATIONS	3 – 8
3.1.2–1	UIP LOCATION AND DIMENSIONS	3 – 9
3.1.2–2	USL SPECIFIC CONNECTOR LOCATIONS	3 – 10
3.2.1.1–1	UIP ELECTRICAL POWER CONNECTORS AND PIN ASSIGNMENTS	3 – 13
3.2.2.1–1	RACK BONDING INTERFACE PROFILE	3 – 14
3.2.2.1–2	RACK BONDING SURFACE (BOTTOM VIEW)	3 – 15
3.2.2.1–3	RACK BONDING INTERFACE LOCATIONS	3 – 16
3.2.5.1–1	FIR LOAD IMPEDANCE	3 – 19
3.2.5.2–1	3 KW INTERFACE POWER SOURCE IMPEDANCE LIMITS	3 – 20
3.2.5.2–2	6 KW INTERFACE B POWER SOURCE IMPEDANCE LIMITS	3 – 21
3.2.5.2–3	1.2 – 1.44 KW INTERFACE B POWER SOURCE IMPEDANCE LIMITS	3 – 22
3.2.6–1	FIR OVERLOAD PROTECTION CHARACTERISTICS	3 – 24
3.2.6–2	USL OVERLOAD PROTECTION CHARACTERISTICS	3 – 25
3.2.7–1	FIR SURGE CURRENT	3 – 28
3.2.7–2	ELECTRICAL SCHEMATIC OF THE FIR OR ELECTRICAL POWER CONSUMING EQUIPMENT INTERFACING TO THE UIP	3 – 29
3.3.1–1	INTEGRATED DATA FLOW SCHEMATIC	3 – 30
3.3.2.2–1	PAYLOAD 1553B BUS A CONNECTOR PIN / ASSIGNMENT – J3	3 – 32
3.3.2.2–2	PAYLOAD 1553B BUS B CONNECTOR / PIN ASSIGNMENT – J4	3 – 33
3.3.3.1–1	USL LAN–1 INTERFACE CONNECTOR / PIN ASSIGNMENT – J46	3 – 35
3.3.3.1–2	USL LAN–2 INTERFACE CONNECTOR / PIN ASSIGNMENT – J47	3 – 36
3.3.3.1–3	ISS PAYLOAD MRDL ARCHITECTURE	3 – 37
3.3.4.1–1	STANDARD HIGH RATE DATA CONNECTOR PART NUMBER AND PIN ASSIGNMENT – J7	3 – 39
3.3.5.1–1	FIR POWER REMOVAL SWITCH / FIRE DETECTION SUPPORT INTERFACE CONNECTOR / PIN ASSIGNMENTS – J43	3 – 40
3.3.5.2–1	PRINCIPLE CIRCUIT FOR THE SMOKE SENSOR INTERFACE	3 – 41
3.3.5.2–2	FAN AND SMOKE INDICATOR LED CIRCUIT	3 – 42
3.3.5.3–1	RACK MAINTENANCE SWITCH INTERFACE	3 – 43
3.4.1.2–1	OPTICAL VIDEO CONNECTOR / PIN ASSIGNMENT – J16	3 – 45
3.5.1.2–1	FIR FLUID LOOP SCHEMATIC	3 – 47

FIGURES (Continued)

FIGURE		PAGE
3.5.1.2–2	U.S. LAB AVAILABLE PRESSURE DROP VS. FLOW RATE	3 – 48
3.5.1.2–3	FIR PRESSURE DROP VS. FLOW RATE	3 – 49
3.6.1–1	USL VES / WGS INTERFACE LOCATIONS	3 – 52
3.6.2–1	USL VRS / VVS INTERFACE LOCATIONS	3 – 54
3.7–1	FIR PRESSURIZED GAS SCHEMATIC	3 – 55
3.9.1.2–1	FIR VIBRATORY DISTURBANCE	3 – 57

(This Page Intentionally Left Blank)

1.0 INTRODUCTION

1.1 PURPOSE

This Interface Control Document (ICD) is the primary source of design implementation and module specific interfaces of the Pressurized Payload Interface Requirements Document. This hardware controls the ISS and Fluids and Combustion Facility (FCF) Fluids Integrated Rack (FIR) interfaces for integration into the United States Laboratory (USL) and the Multi-Purpose Logistics Module (MPLM). The physical, functional, and environmental design implementation associated with payload safety and interface compatibility are included herein.

1.2 SCOPE

The interfaces defined in this document apply to transportation and on-orbit phases of the payload mission cycle for the FCF FIR. Transportation interfaces are specific to the MPLM. The reader is referred to NSTS 21000–IDD–MDK for requirements related to transportation in the Shuttle Middeck area and SSP 50018 for requirements related to ISS stowage.

1.3 USE

Section 3 of this document contains the FIR design implementation and module specific interface information while Section 4 has an applicability matrix that provides traceability back to the specific interface design requirements applicable to the FIR contained in SSP 57000, the Pressurized Payload Interface Requirements Document (IRD). The specific verification methods for each IRD interface design requirement will be documented in SSP 57418, FIR Unique Payload Verification Plan (PVP). The FCF project will be responsible for providing the specific FIR interface information in Section 3 for each applicable interface as well as identifying all applicable IRD requirements for that interface in the applicability matrix contained in Section 4. In addition, Section 5 contains a table that FIR Project will utilize to document exceptions to the applicable requirements in SSP 57000 or the module specific interfaces defined in SSP 57001. The FCF project will be responsible for providing any analysis or documentation required to evaluate and disposition identified exceptions to the IRD. Figure 1.3–1 shows the inter–relationship of the IRD, ICD Template, and the FCF FIR Hardware ICD.

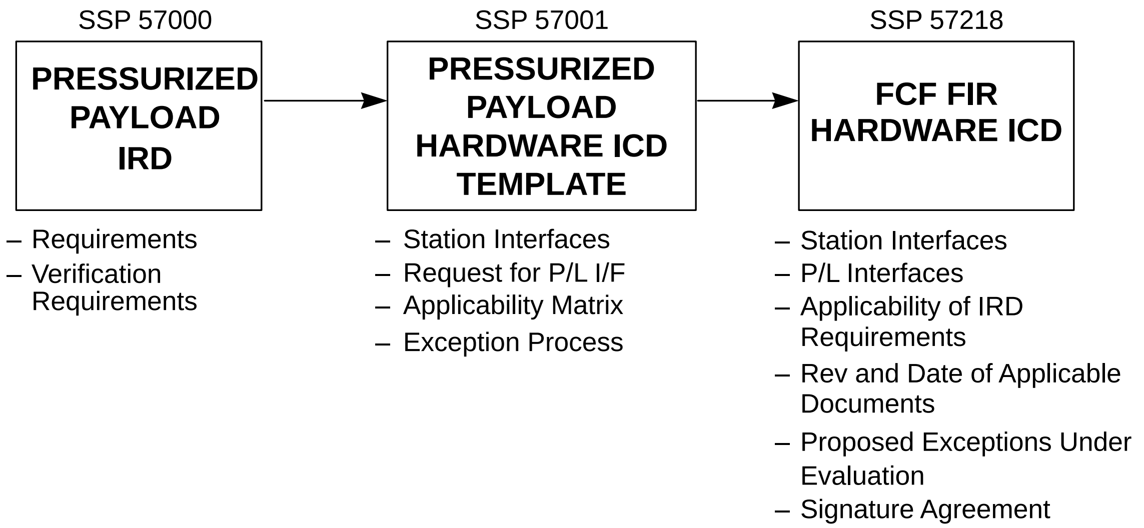


FIGURE 1.3–1 PAYLOAD INTERFACE REQUIREMENTS AND CONTROL PROCESS

1.4 PAYLOAD DESCRIPTION

The FCF is an International Space Station (ISS) research facility located in the USL. The FCF performs microgravity research in fluids physics science and combustion science. This facility remains on–orbit and provides accommodations to Principle Investigator (PI)–unique hardware. The fully deployed facility will support a minimum of five (5) PI’s per year in each of the fluids physics science and combustion science disciplines. The FCF also accommodates commercial and international investigations on an availability basis.

The facility is comprised of three powered International Standard Payload Racks (ISPRs), each equipped with the Active Rack Isolation System (ARIS). The FCF is incrementally launched with the Combustion Integrated Rack (CIR) as the Initial Deployment. The Intermediate Deployment is composed of the CIR and the FIR. The CIR and the FIR operate independently until the Shared Accommodations Rack (SAR) is added and the FCF becomes Fully Deployed as shown in Figure 1.4–1.

Prior to the deployment of the SAR, the CIR and the FIR function as autonomous racks allowing early combustion and fluid physics research opportunities on Station. The CIR and FIR physical envelope, mass and functional aspects limit the amount of experiments that can be accomplished within these racks. With the addition of the SAR and reconfiguration of the CIR and FIR, assembly of the FCF is complete. The fluid physics and combustion science disciplines then share the capabilities of the three FCF racks and necessary hardware within the FCF to accommodate the full fluid/combustion science envelope over the facility’s ten–year post–assembly complete life cycle.

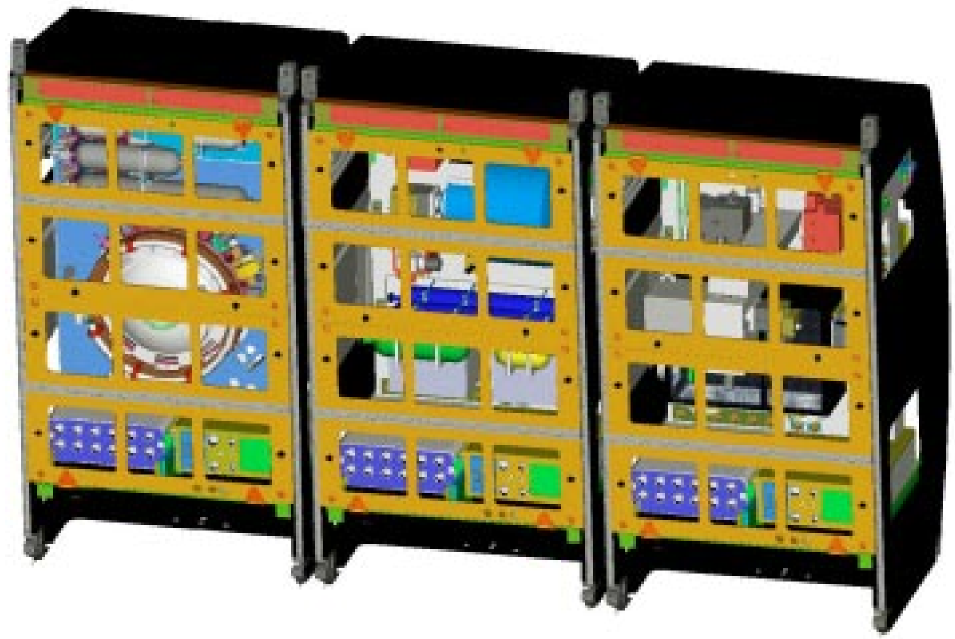


FIGURE 1.4–1 FLUIDS AND COMBUSTION FACILITY

The FCF utilizes design commonality across the three racks in the following subsystems:

A. Structure

- ISPR–4
- ARIS
- Rack Door
- Optics Bench Deployment Mechanism

B. Electrical

- Electrical Power Control Unit (EPCU)

C. Command and Data Management

- Diagnostics Control Module (DCM)
- Input/Output Processor (IOP)
- Image Processing and Storage Units (IPSU)

D. Environmental Control System (ECS)

- Air Thermal Control Unit (ATCU)
- Water Thermal Control System (WTCS)
- Fire Detection and Suppression
- Gas Interface System

The intermediate deployment adds the FIR, shown in Figure 1.4–2, to the on–orbit CIR. In addition to the common subsystems listed above, the FIR is comprised of the following:

A. Fluid Science Optics Bench

B. FIR Specific Diagnostics (Illumination)

- Light Emitting Diode (LED) Array Package
- White Light Package
- Neodydium (ND): Yttrium Argon Garnet (Yag) Laser Package
- Laser Diode Package
- Collimator Package

C. FIR Specific Diagnostics (Imaging)

- High Resolution Camera Package
- Lens System
- Color Camera Package
- Optical Package

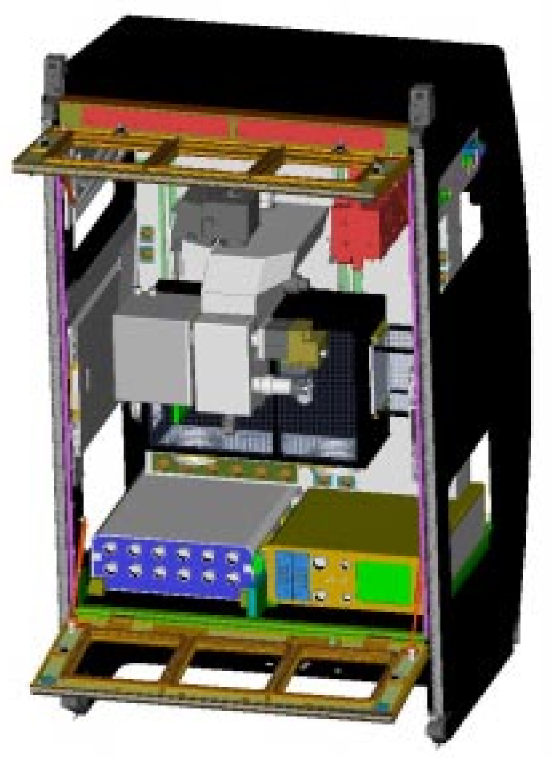


FIGURE 1.4–2 FLUIDS INTEGRATED RACK

Both the crew and ground operations personnel operate the FCF. The crew sets up and prepares the FCF payloads for semi–automated operations. Experiment set–up involves installation of PI unique hardware and samples, and reconfiguration of the diagnostics.

Data collected over the course of PI experiment test runs is processed and stored within the FCF. A portion of this data may be downlinked in near–real time for decision making and/or engineering analysis. Once the PI experiment test run is concluded, FCF reduces power and transmits data at off–peak times or at low data rates. The crew removes PI unique hardware and restores and/or reconfigures the facility for continuing PI experiments.

1.4.1 PAYLOAD FUNCTION

The ISS FCF is a multidiscipline research facility that provides accommodations to investigate combustion and fluids phenomenon in a sustained microgravity environment. Investigations performed in a microgravity environment provide unique insight into the behavior of fluids and combustion science. The combustion portion of the FCF supports investigation and observation of laminar flames, turbulent combustion, droplet and spray combustion, and other types of combustion research.

The FCF is operated by both the crew and ground operations personnel. The crew sets up and prepares the FCF payloads for semiautomated operations. Experiment setup involves installation of PI–unique hardware and samples and reconfiguration of the diagnostics. The crew also performs maintenance and upgrades to the facility.

Data collected over the course of PI experiment test runs is processed and stored within the FCF. A portion of this data may be downlinked in near real–time for decision making and/or engineering analysis. The crew removes PI–unique hardware and restores and/or reconfigures the facility for continuing PI experiments.

The FCF is deployed on–orbit in a staged sequence; thus, the operations scenario adjusts with the deployment process. The CIR and FIR will operate as independent racks until the SAR rack is installed on–orbit. At that time, the FCF transitions to an operational mode that may include CIR–only, FIR–only, CIR–SAR, FIR–SAR, or CIR–SAR–FIR racks, depending on the resources available and the science requirements.

Once the FIR has been installed in the US Lab, set up, and tested, experiment operations will begin. FIR payload hardware will be removed from stowage and installed into the FIR. This will include either installing or reconfiguring the fluids diagnostics hardware on the FIR optics bench. Installation and/or reconfiguration of the diagnostics and PI hardware will normally require that the rack doors be opened and the optics bench be moved out from within the rack. After the experiment setup activities are completed, the experiment will typically be run using pre–programmed routines and commands from the ground teams. The typical fluids experiment may take anywhere from many minutes to hundreds of hours to be completed. Not that many of the fluids experiments continue to “operate” passively in the absence of external power (i.e., colloidal physics experiments). FIR science sample changeout may require crew interaction. Additionally, science sample preparation (mix/melt/monitor, etc.) may take place in the SAR and also may require science crew interface. A microgravity environment is required during the experiment operation period. When an experiment run is complete, the FIR will be safed and powered down, possibly requiring crew involvement.

2.0 DOCUMENTATION

The following documents shown include specifications, models, standards, guidelines, handbooks, and other special publications. Specific date and revision number of documents under control of the Space Station Control Board (SSCB) can be found in SSP 50257, Program Control Document Index or SSP 50258, Prime Control Document Index. The documents in this section are inclusive to those specified in this document in addition to the applicable requirements of Section 4 and form a part of this document. In the event of a conflict between the documents referenced and the contents of this ICD, the contents of this ICD shall be considered a superseding requirement.

2.1 APPLICABLE DOCUMENTS

DOCUMENT NO.	TITLE
220G07500	Teledyne Brown Engineering Drawing – Shipping
683–16348	Coupling, Quick Disconnects, Fluid, Self–sealing, Internal Envelope Drawing
683–50243–4	ISPR Drawing
MIL–C–38999	Connector, Electrical Circular, Miniature, High Density, Quick Disconnect, Environment Resisting, Removable Crimp and Hermetically Soldered Contacts
MIL–STD–1553B	Digital Time Division Command/Response Multiplex Data Bus Handbook
NSTS 1700.7B, ISS Addendum	Safety Policy and Requirements for Payloads using the International Space Station System
SSP 30426	External Contamination Control Requirements
SSP 30482 (V1)	Electric Power Specifications and Standards, Vol. 1: EPS Performance Specifications
SSP 30482 (V2)	Electric Power Specifications and Standards, Vol. 2: Consumer Constraints
SSP 30573	Space Station Program Fluid Procurement and Use Control Specification
SSP 41002	International Standard Payload Rack to NASA/ESA/NASDA Modules Interface Control Document
SSP 41017	Rack to Multi–Purpose Logistics Module Interface Control Document (ICD) Part 1 and 2
SSP 41162	Segment Specification for the United States On–Orbit

DOCUMENT NO.	TITLE
SSP 50018	Packaging and Configuration Requirements Document
SSP 52051	ISS User Power Quality Specification
SSP 57000	Pressurized Payload Interface Requirements Document
SSP 57001	Pressurized Payload Interface Control Document Template
SSP 57010	Generic Payload Verification Plan
SSQ 21635	Connectors and Accessories, Electrical, Circular, Miniature, Intravehicaular Activity (IVA) / Extravehicular Activity (EVA) / Robot Compatible, Space Quality, General Specifications for Document Rectangular, Rack and Panel
SSQ 21655	Cable, Electrical, MIL-STD-1553 Data Bus, Space Quality, General Specification for Document
SSQ 21676	Coupler, Data Bus, MIL–STD–1553B; Space Quality, General Specification
SSQ 26678	Interconnection, MIL–STD–1553B; Space Quality, General Specification

2.2 UNIQUE ICD APPLICABLE DOCUMENTS

Rack integrators will be developing their integrated racks to the current version of SSP 57000 and the Pressurized Payload IRD applicable documents that correspond to requirements marked as applicable in the Chapter 4 Applicability Matrix of their unique ICD. This matrix provides the traceability back to the applicable IRD requirement and hence the corresponding verification requirement. Rack integrators will be responsible for impacting any changes processed as ISS Payload Office PIRNs to these applicable documents and report to the ISS Program Office as to whether the changes impact them. Changes that impact integrated rack development will be handled with either a waiver or design change that is approved by the ISS Program Office.

3.0 PAYLOAD INTERFACE

3.1 STRUCTURAL/MECHANICAL

3.1.1 RACK ATTACHMENT INTERFACES

3.1.1.1 GSE INTERFACES

D. The KSC Rack Insertion Device (RID) attaches to the GSE interfaces on the front of the FIR as defined in SSP 41017 Part 2, paragraph 3.3.3, Ground Handling Attachment Interfaces, and will accommodate only the payload protrusions identified in SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope. It also pivots the FIR to install it into the MPLM. The pivot keepout envelope is also identified in SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope. RID Ground handling loads for GSE points E, F, G, H are identified in SSP 41017 Part 1, paragraph 3.2.1.4.3 Interface Loads, and are much less than the launch and landing loads for points A, B, C, and D. The NASA 683–50243–4 ISPR and the NASDA ISPR meet the interfaces defined above.

   FIR protrusions which affect ground processing are illustrated in Figure 3.1.1.1–1. The FIR is ARIS equipped and will utilize a removable umbilical design. The FIR umbilicals will launch in a stowage location and be attached on orbit.

E. All integrated racks may be shipped in an ISS–provided Rack Shipping Container (RSC). The FIR interfaces to the RSC per Teledyne Brown Engineering (TBE) drawing 220G07500, Shipping Container Integrated Assembly. The RSC accommodates the static envelope of the ISPR identified in SSP 41017 Part 1, paragraph 3.2.1.1.2, Static Envelope.

   The FIR will utilize an ISS–provided RSC for shipping.

F. All NASA ISPRs are integrated in a Rack Handling Adapter (RHA). NASDA Racks may be integrated in a NASDA Rack Stand. The KSC Payload Test and Checkout System (PTCS) will only accommodate an integrated rack in an ISS RHA with SSPF Base. The FIR interfaces with the RHA per TBE drawings 220G07455, Upper Structure Assembly; 220G07470, MSFC Base Assembly; and 220G07475, SSPF Base Assembly. The RHA accommodates the static envelope of the ISPR identified in SSP 41017 Part 1, paragraph 3.2.1.1.2, Static Envelope.

   The FIR will be integrated in an ISS–provided RHA for rack handling and integration.

(TBD #1)

FIGURE 3.1.1.1–1 FIR GROUND OPERATIONS RACK PROTRUSIONS (SHEET 1 OF 2)

(TBD #1)

FIGURE 3.1.1.1–1 FIR GROUND OPERATIONS RACK PROTRUSIONS (SHEET 2 OF 2)

3.1.1.2 MPLM INTERFACES

A. MPLM interfaces for rack attach points A, B, (lower rear attach points) C, D (upper kneebrace attach points) and pivot points I, J are identified in SSP 41017 Part 2, Figure 3.1.1–1. Any MPLM location restrictions are identified in Figure 3.1.1.2–1.

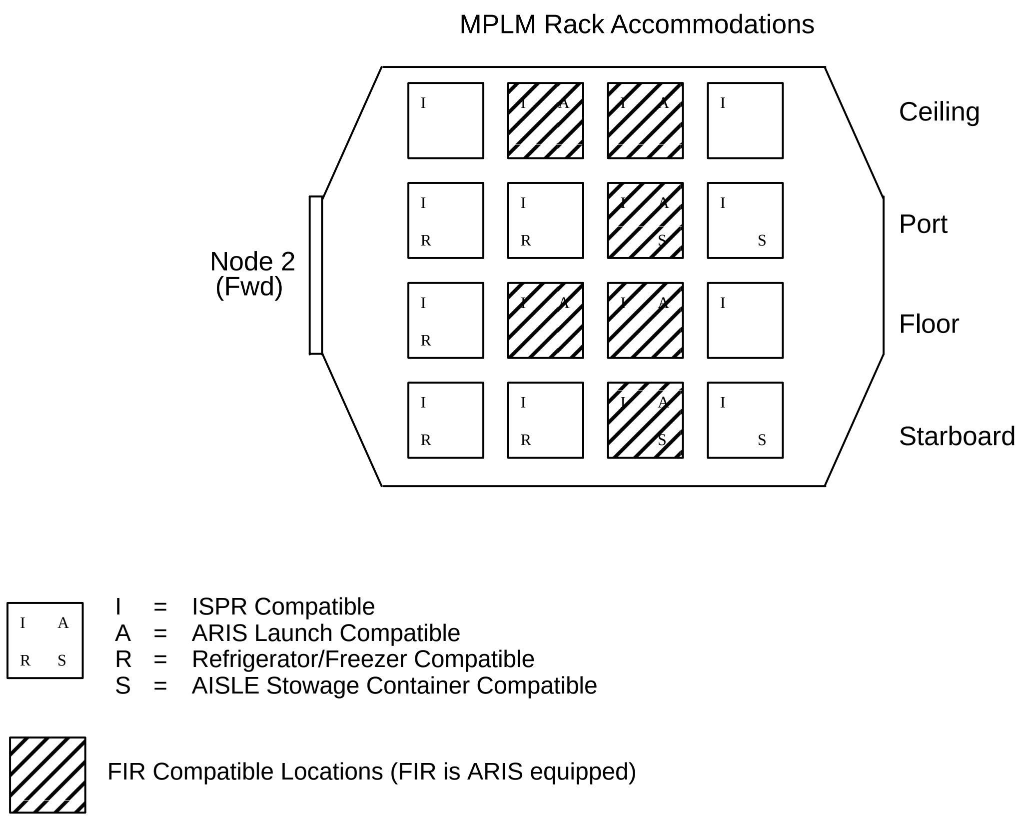


FIGURE 3.1.1.2–1 MPLM RACK RESTRICTIONS

B. The FIR launch mass and Center of Gravity (CG) are defined in Table 3.1.1.2–1.

TABLE 3.1.1.2–1 FIR MASS AND CENTER OF GRAVITY (CG)

PHASE	MASS (lbs)	CG (in)
Integration	**(TBD #2)**	x: y: z:
Launch		x: y: z:
On–Orbit		x: y: z:
Landing		x: y: z:

Note: The CG reference point is the Rack Datum Point defined in Figure 3.1.3–1, Rack Coordinate System, of SSP 41017 Part 2.

3.1.1.3 ISS INTERFACES

A. The FIR interfaces to the ISS at attachment point locations C, D, I and J as defined in SSP 41017 Part 1, Section 3.2.1.1.1 and SSP 41047 Part 2, Section 3.1.1. The NASA and NASDA ISPRs meet these interfaces.

B. FIR temporary on–orbit protrusions are identified in Figure 3.1.1.3–1*. The maximum rack rotation angle during installation and maintenance activities i**s (TBD #3)**.

> * This condition represents an exception to requirements found in SSP 57000, Paragraph 3.1.1.7.3.A. See Section 5.0, exception identifier E–01, PIRN number 57218–NA–0001, for a description of the exception.

C. The FIR Portable Fire Extinguisher (PFE) access port, Rack Maintenance Switch (rack power switch), Smoke Indicator LED, and all Caution and Warning labels must be clearly visible and unobstructed. A keep–out zone must be maintained for insertion of the PFE bottle. Figure 3.1.1.3–2 identifies the location of the PFE access port, Rack Maintenance Switch (rack power switch), Smoke Indicator LED, and all Caution and Warning labels.

D. The FIR on–orbit mass and CG are defined in Table 3.1.1.2–1.

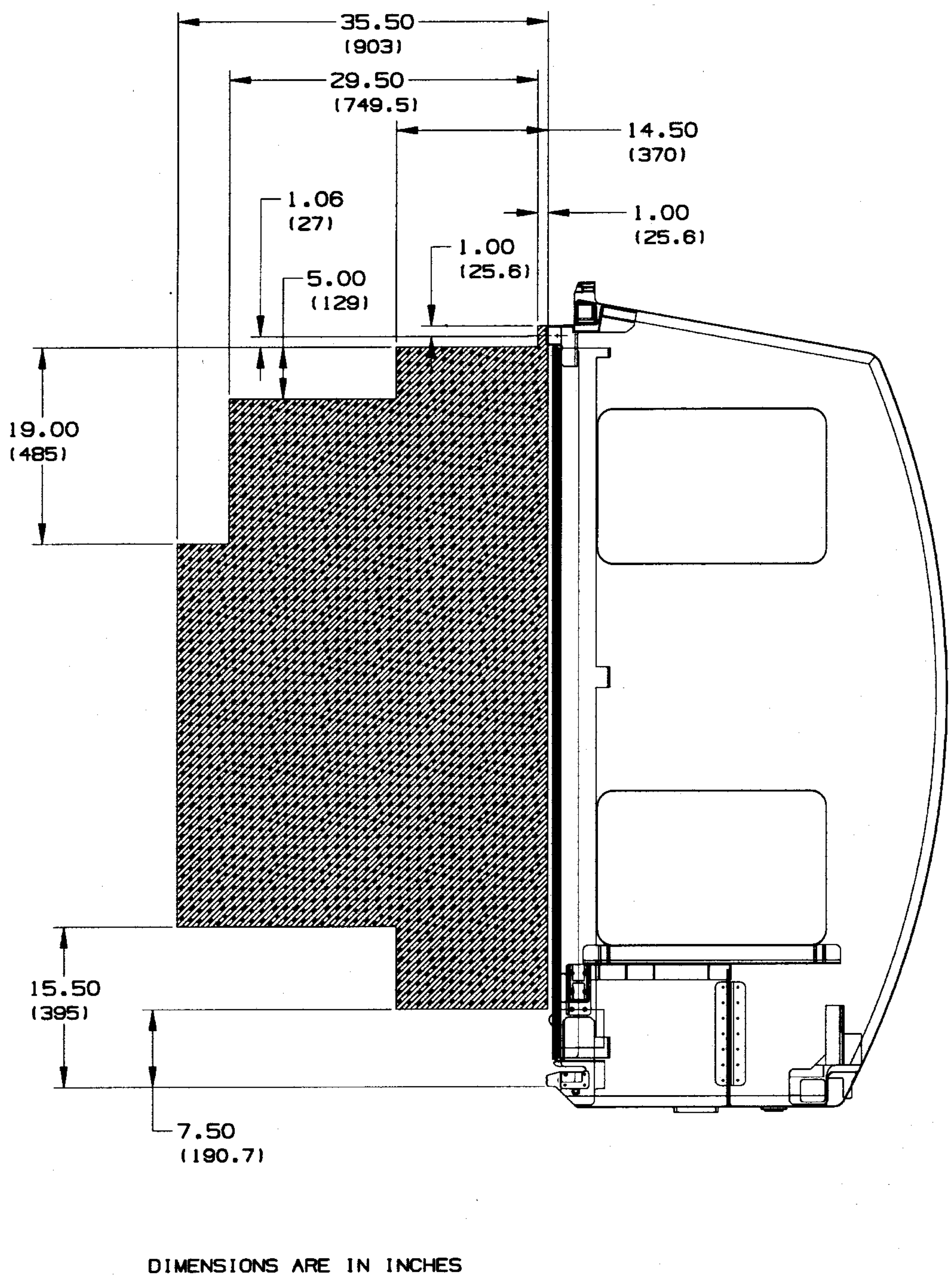


FIGURE 3.1.1.3–1 RACK DOOR PROTRUSION ENVELOPE (SHEET 1 OF 2)

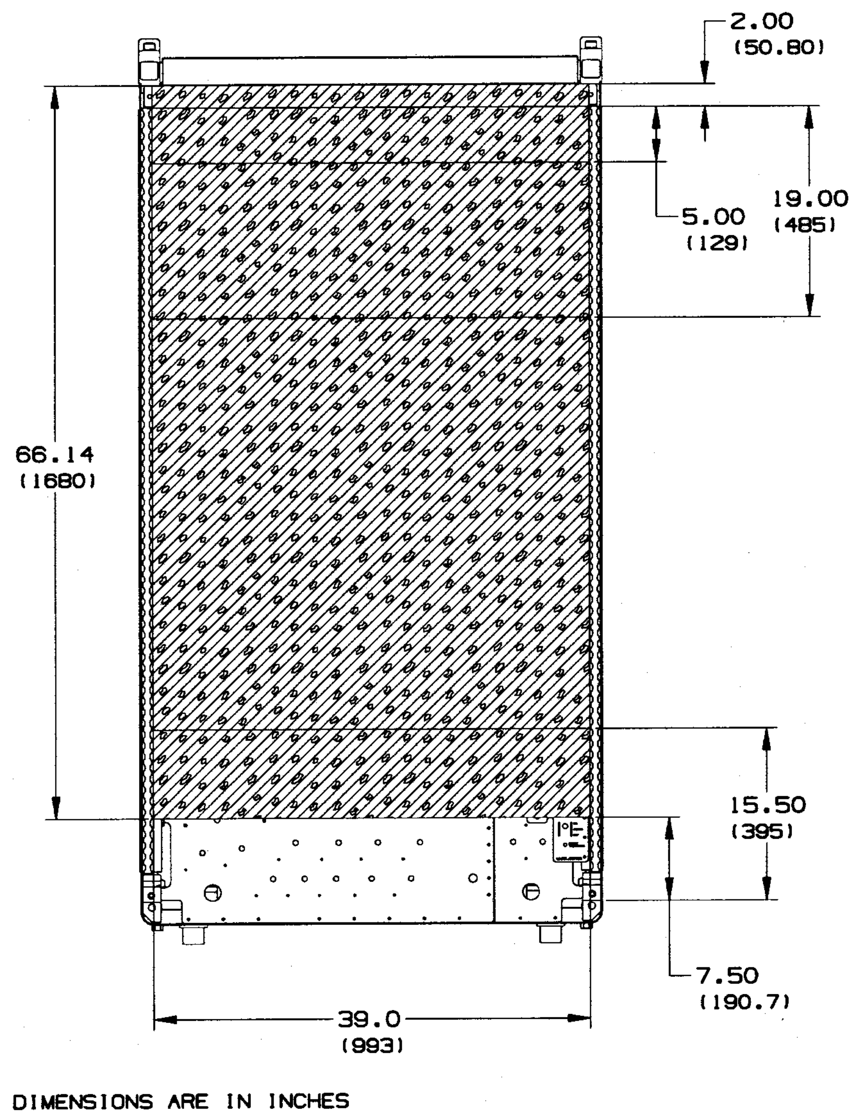


FIGURE 3.1.1.3–1 RACK DOOR PROTRUSION ENVELOPE (SHEET 2 OF 2)

(TBD #4)

FIGURE 3.1.1.3–2 PFE ACCESS PORT, RACK MAINTENANCE SWITCH, SMOKE INDICATOR LED, AND C&W LABEL LOCATIONS

3.1.1.3.1 RACK TO RACK UMBILICAL DESIGN (TBD #5)

3.1.2 CONNECTOR INTERFACES

The physical interface of the FIR to ISS system services is at the Utility Interface Panel (UIP). The UIP location is shown in Figure 3.1.2–1. The ISS system services connector layout at the UIP is shown in Figure 3.1.2–2. The ISS system services connectors are defined in Table 3.1.2–1.

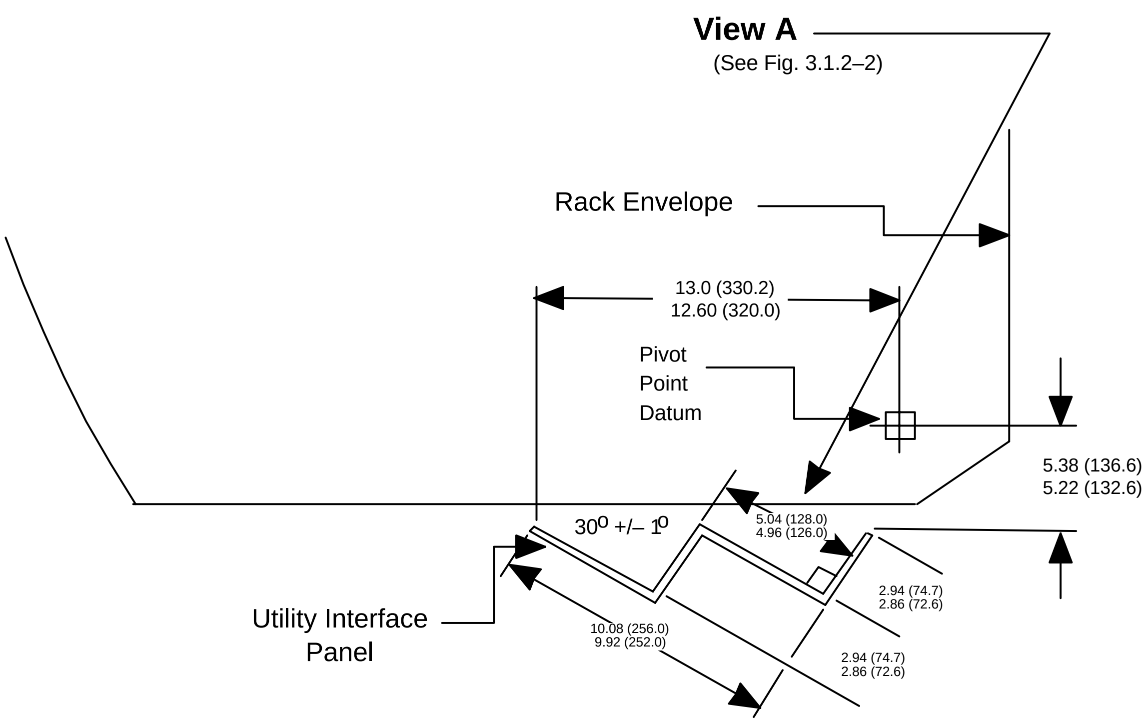
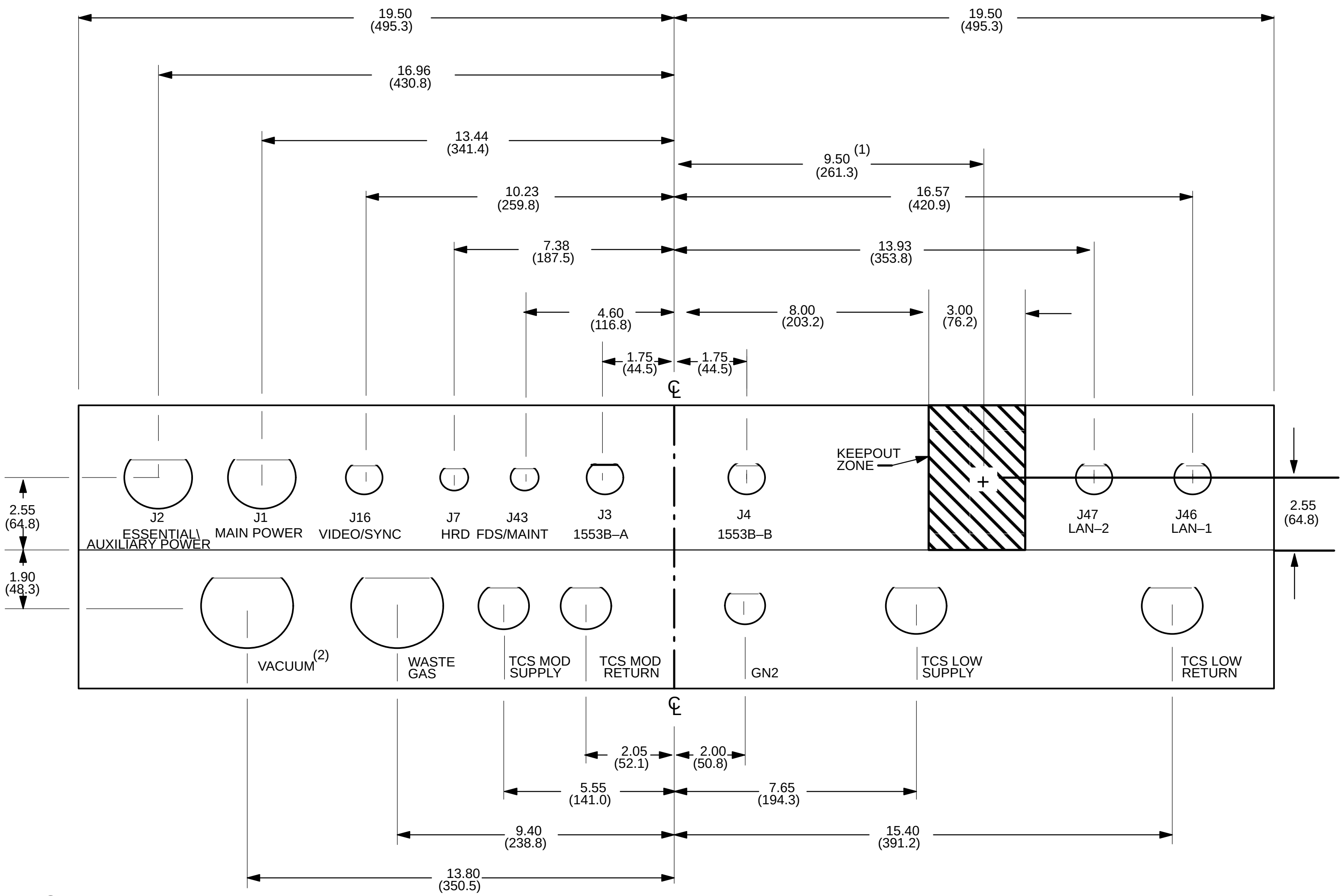


FIGURE 3.1.2–1 UIP LOCATION AND DIMENSIONS



NOTE:
1) Camlock Receptacle, part number 991R2–1BP, to be installed at location shown.
2) Not available on USL Racks LAB1P1, LAB1P2, LAB1P4, LAB1D3.
3) All dimensions are nominal dimensions.

FIGURE 3.1.2–2 USL SPECIFIC CONNECTOR LOCATIONS

TABLE 3.1.2–1 ISS SYSTEM SERVICES CONNECTOR PART NUMBERS

ISS Resource	ISS Connector Designation	ISS UIP Receptacle Part Number		ARIS UIP Mating Connector Part Number		ARIS RUP Mating Connector Part Number		FIR ARIS RUP Receptacle Part Number
UIP								
Main Power	J1	NATC07T25LN3SN	P1	NATC06G25LN3PN	P1	NATC06G25LN3SN	J1	NATC07T25LN3PN
Essential/Auxiliary Power	J2	NATC07T25LN3SA	P2	NATC06G25LN3PA	P2	NATC06G25LN3SA	J2	NATC07T25LN3PA
MIL–STD–1553B Bus A	J3	NATC07T15N35SN	P3	NATC06G15N35PN	P3	NATC06G15N35SN	J3	NATC07T15N35PN
MIL–STD–1553B Bus B	J4	NATC07T15N35SA	P4	NATC06G15N35PA	P4	NATC06G15N35SA	J4	NATC07T15N35PA
HRDL	J7	NATC07T13N4SN	P7	NATC06G13N4PN	P7	NATC06G13N4PN	J7	NATC07T13N4SN
Optical Video	J16	NATC07T15N97SB	P16	NATC06G15N97PB	P16	NATC06G15N97PB	J16	NATC07T15N97SB
FDS/Power Maintenance	J43	NATC07T13N35SA	P43	NATC06G13N35PA	P43	NATC06G13N35SA	J43	NATC07T13N35PA
EWACS	J45	NATC07T11N35SC		N/A		N/A		N/A
LAN–1	J46	NATC07T11N35SA	P46	NATC06G11N35PA	P46	NATC06G11N35SA	J46	NATC07T11N35PA
LAN–2	J47	NATC07T11N35SB	P47	NATC06G11N35PB	P47	NATC06G11N35SB	J47	NATC07T11N35PB
Electrical video	J77	NATC07T13N35SB		N/A		N/A		N/A
TCS Moderate Temp Loop Supply	TCS MOD SUPPLY	683–16348, Male Category 6, Keying B		683–16348, Female, Category 6, Keying B		683–16348, Female, Category 6, Keying B		683–16348–248, Male, Category 6, Keying B (+75)
TCS Moderate Temp Loop Return	TCS MOD RETURN	683–16348, Male, Category 6, Keying C		683–16348, Female, Category 6, Keying C		683–16348, Female, Category 6, Keying C		683–16348–249, Male, Category 6, Keying C (+105)
TCS Low Temp Loop Supply	TCS LOW SUPPLY	683–16348, Male, Category 6, Keying B		N/A		N/A		N/A
TCS Low Temp Loop Return	TCS LOW RETURN	683–16348, Male, Category 6, Keying C		N/A		N/A		N/A
Waste Gas System	WASTE GAS	683–16348, Male, Category 3, Keying B		683–16348, Female, Category 3, Keying B		683–16348, Female, Category 3, Keying B (–120)		683–16348–57, Male, Category 3, Keying B (+120)
Vacuum Resource System	VACUUM	683–16348, Male, Category 3, Keying A		683–16348, Female, Category 3, Keying A		683–16348, Female, Category 3, Keying A (–60)		683–16348–15, Male, Category 3, Keying A (+60)
Gaseous Nitrogen	GN_2	683–16348, Male, Category 8, Keying B		683–16348, Female, Category 8, Keying B		683–16348, Female, Category 8, Keying B (–25)		683–16348–332, Male, Category 8, Keying B (+75)
Argon	Ar	683–16348, Male, Category 8, Keying C		N/A		N/A		N/A
Helium	He	683–16348, Male, Category 8, Keying E		N/A		N/A		N/A
Carbon Dioxide	CO_2	683–16348, Male, Category 8, Keying D		N/A		N/A		N/A
Fluid Services								
Potable Water	Potable Water	683–16348, Male, Category 7, Keying D		N/A		N/A		N/A
Fluid System Servicer	Fluid System Services	683–16348, Male, 0.50 inch QD, universal (no keying)		683–16348, Female, 0.50 inch QD, universal (no keying)		683–16348, Female, 0.50 inch QD, universal (no keying)		683–16348, Male, 0.50 inch QD, universal (no keying)

3.2 ELECTRICAL POWER INTERFACES

3.2.1 CONNECTORS

3.2.1.1 UTILITY INTERFACE PANEL

The FIR electrical power connectors, J1 and J2, interfaces at the UIP are defined in Figures 3.1.2–1 and 3.1.2–2. The J1 and J2 part numbers are defined in Table 3.1.2–1 and the pin assignments are defined in Figure 3.2.1.1–1.

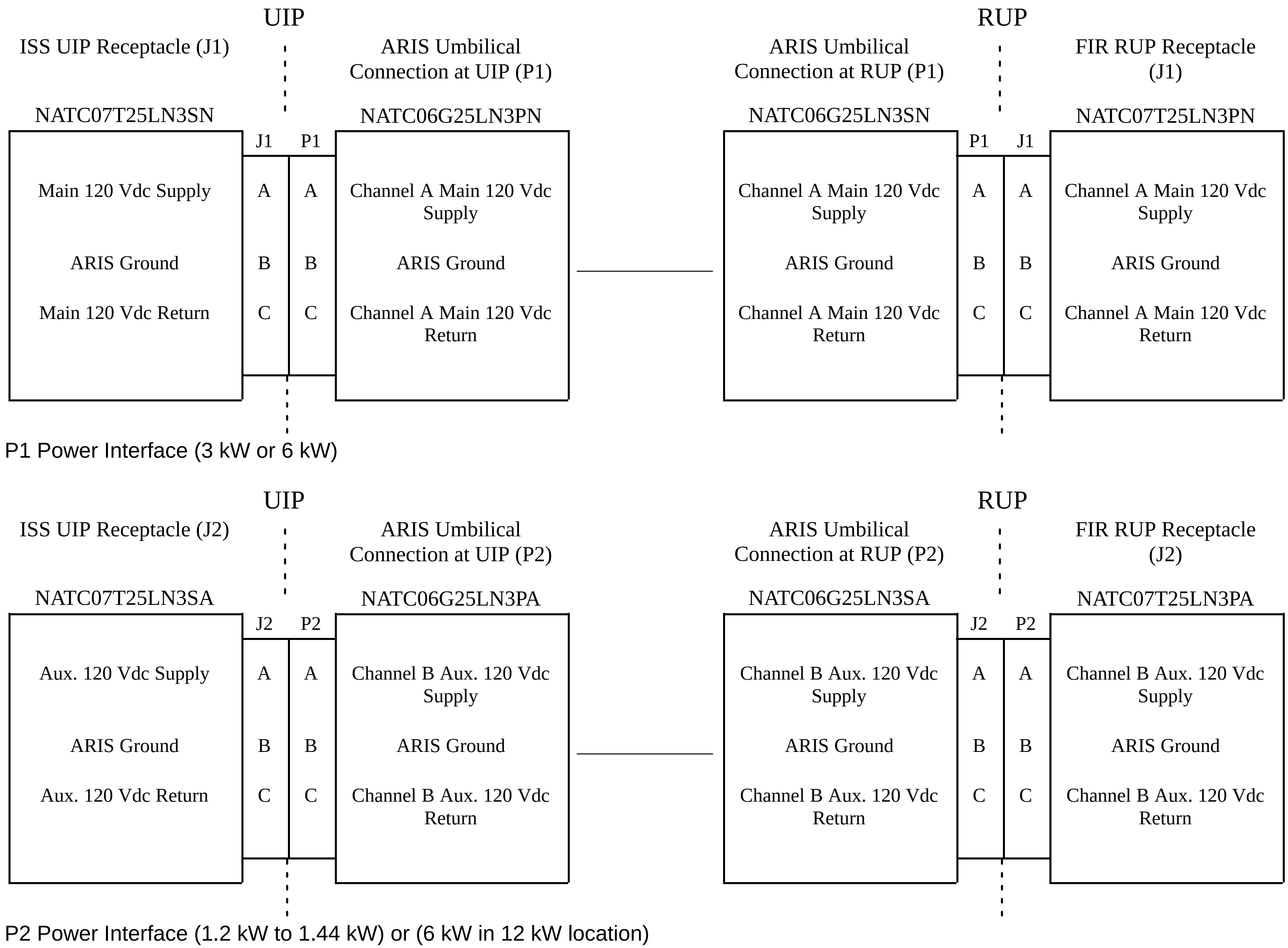


FIGURE 3.2.1.1–1 UIP ELECTRICAL POWER CONNECTORS AND PIN ASSIGNMENTS

3.2.1.2 UTILITY OUTLET PANEL

The FIR will not require an interface to the Utility Outlet Panel (UOP).

3.2.2 ELECTROMAGNETIC COMPATIBILITY

3.2.2.1 BONDING

The bonding interface is as shown in Figures 3.2.2.1–1 and 3.2.2.1–2. The surfaces at the bonding interface are electroless nickel plated to a minimum thickness of 0.0015 in. (0.038 mm). Each rack will contain two bonding interfaces as shown in Figure 3.2.2.1–3. The USL will accommodate bonding interfaces as per Table 3.2.2.1–1.

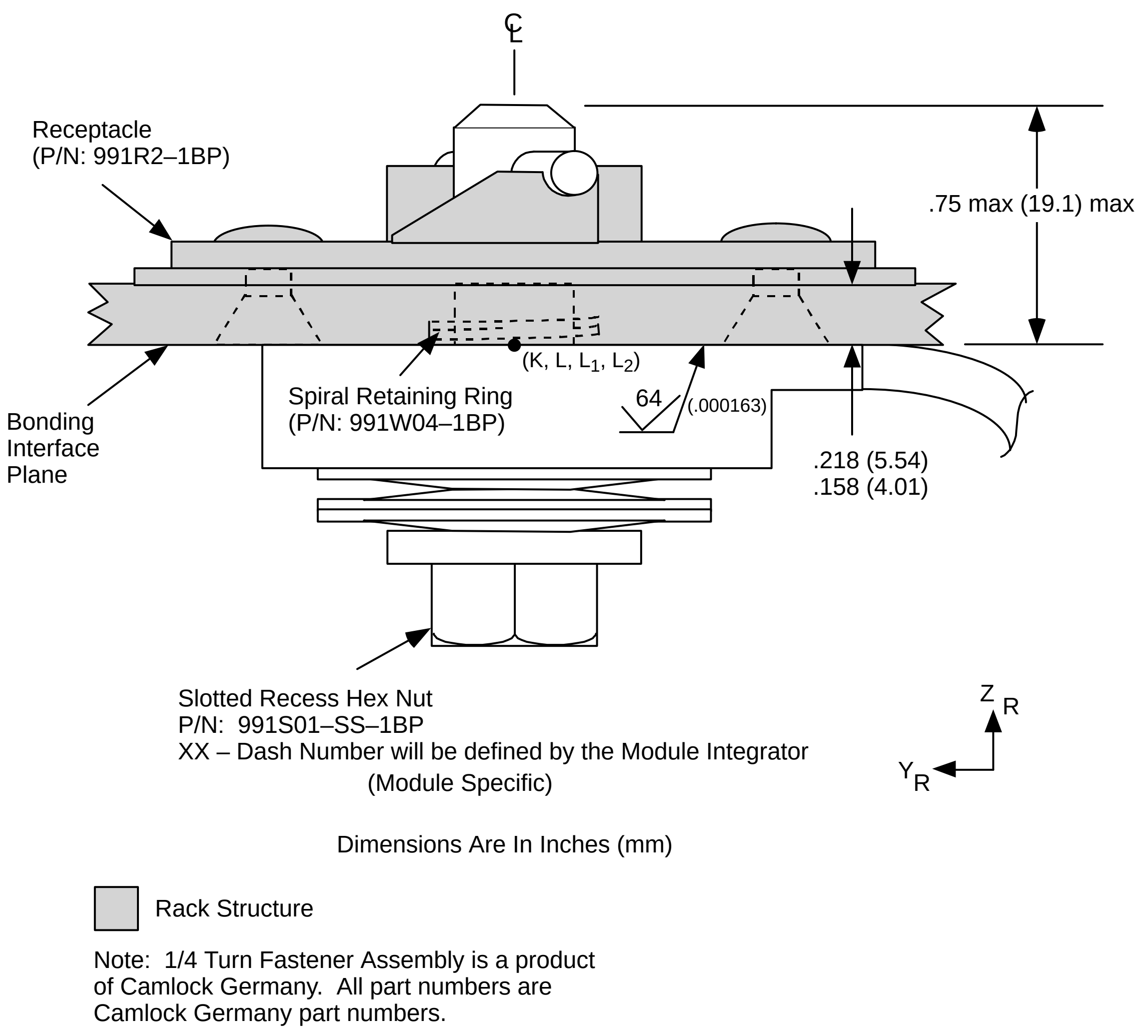
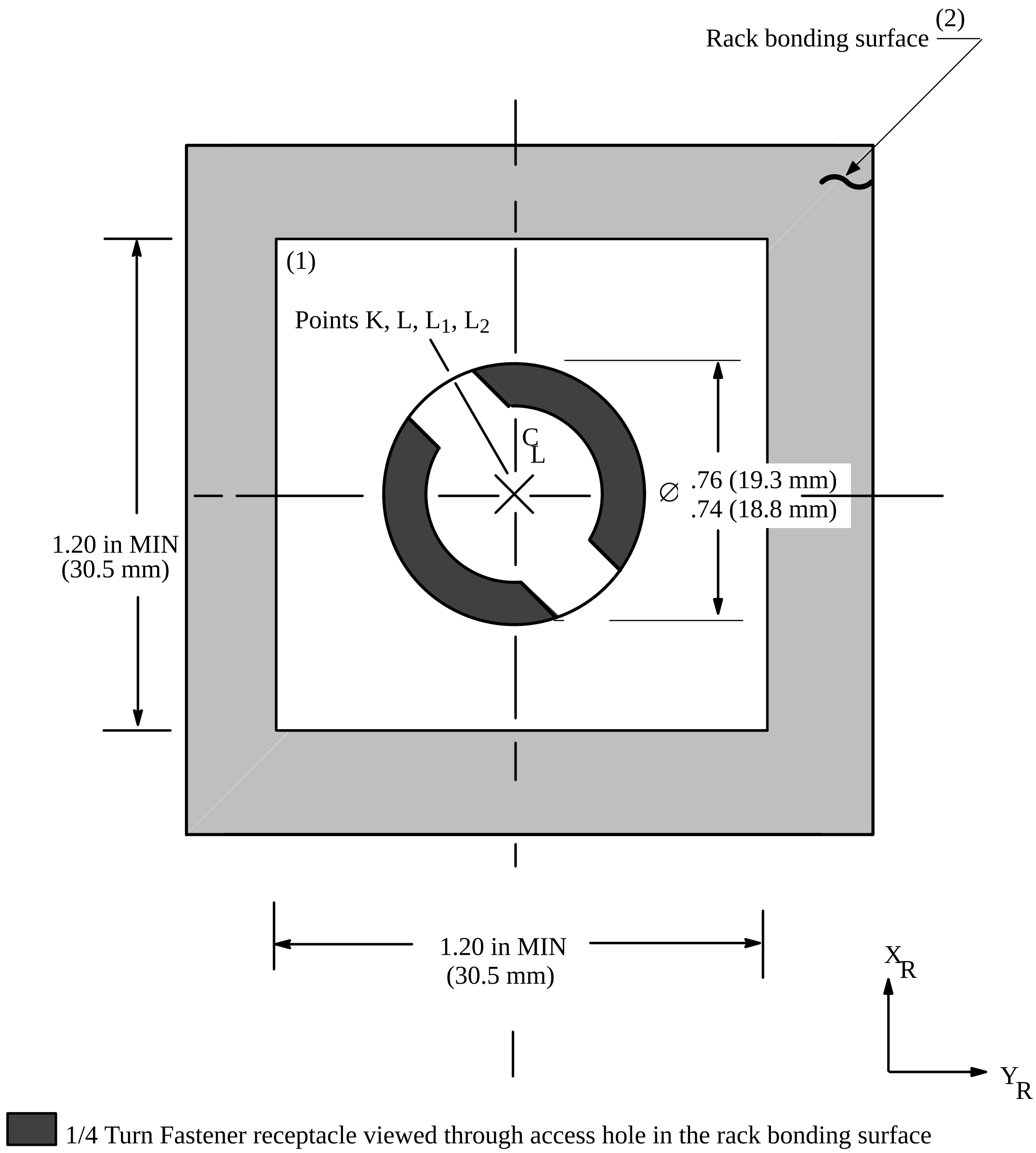


FIGURE 3.2.2.1–1 RACK BONDING INTERFACE PROFILE

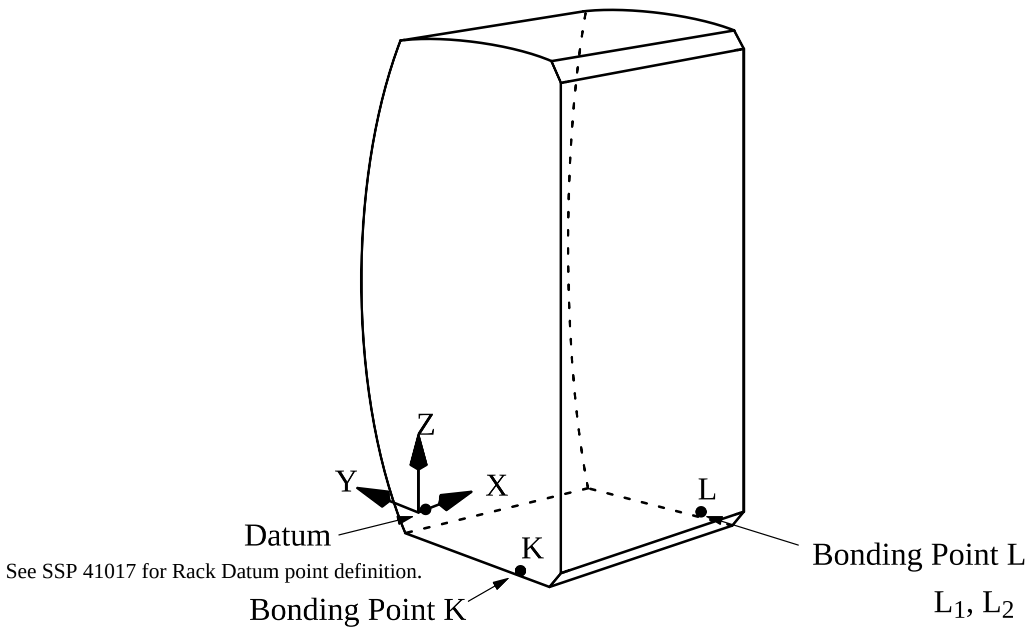


1/4 Turn Fastener receptacle viewed through access hole in the rack bonding surface (Orientation is for reference only)

(1) – Minimum Bonding Surface Contact area
(2) – Reference only

Note: Dimensions are in inches (mm)

FIGURE 3.2.2.1–2 RACK BONDING SURFACE (BOTTOM VIEW)



From Datum	X	Y	Z
Rack Bonding Interface Coordinates (1) K	0.06 (1.5) –0.06 (–1.5)	–16.76 (–425.6) –16.84 (–427.7)	–1.35 (–34.3) –1.59 (–40.4)
Rack Bonding Interface Coordinates L	38.21 (970.5) 38.09 (967.5)	–20.458(–519.6) –20.538(–521.7)	–1.53 (–38.9) –1.59 (–40.4)
Rack Bonding Interface (1) L_1	39.36 (999.7) 39.24 (996.7)	–16.76 (–425.6) –16.84 (–427.7)	–1.35 (–34.3) –1.59 (–40.4)
Rack Bonding Interface (2) L_2	38.21 (970.5) 37.74 (958.6)	–20.458 (–519.6) –20.538 (–521.7)	–1.35 (–34.3) –1.59 (–40.4)

NOTE: Coordinates are defined at the centerline of the access hole shown in Figure 3.2.2.1–2.
(1) – NASDA UNIQUE, NASDA RACKS IN JEM
(2) – NASDA RACK IN USL

FIGURE 3.2.2.1–3 RACK BONDING INTERFACE LOCATIONS

TABLE 3.2.2.1–1 MODULE BONDING INTERFACES

Module	Bonding Interface
USL	Point L, L_2

3.2.2.2 ARIS ISPR BONDING

Bonding for ARIS ISPRs is accomplished through the use of a mesh strap that is provided as part of the ARIS standard umbilical assembly which is part of the ARIS Kit. ARIS ISPRs are bonded to the ISS through an interface on the UOP on the module standoff.

The location of the bonding interface and receptacle on module structure is defined in Figure 3.1.2–2. The receptacle part number is 991R2–1BP (built by Camlock AG) and will be supplied and installed by the module provider.

The ARIS provided bonding strap will include captive fasteners used for mating the bonding strap to the module provided receptacle.

3.2.3 POWER QUALITY

The FIR will receive power that complies with SSP 30482, Volume 1.

3.2.4 POWER HANDLING CAPABILITY

Specific characteristics of ISPR locations are shown in Table 3.2.4–1.

TABLE 3.2.4–1 ISPR LOCATIONS WITH SPECIFIC EPS CHARACTERISTICS

LOCATION	MAIN (kW)	MAIN RPC CURRENT RATING (Amps)	AUXILIARY RPC CURRENT RATING (Amps)	RPC TYPE main/aux.
USL				
LAB1O1	3	25	12	VI/V
LAB1O2	3	25	12	VI/V
LAB1O3	12	*2 – 50	*1 OF 2 – 50	III/III
LAB1O4	6	50	12	III/V
LAB1O5	3	25	12	VI/V
LAB1S1	3	25	12	VI/V
LAB1S2	6	50	12	III/V
LAB1S3	12	*2 – 50	*1 OF 2 – 50	III/III
LAB1S4	6	50	12	III/V
LAB1D3	3	25	12	VI/V
LAB1P1	6	50	12	III/V
LAB1P2	12	*2 – 50	*1 OF 2 – 50	III/III
LAB1P4	6	50	12	III/V

* 12 kW Locations receive power from two independent 6 kW power feeds. Each 6 kW feed contains a Type III RPC for upstream circuit protection.

3.2.5 IMPEDANCE LIMITS

3.2.5.1 LOAD IMPEDANCE LIMITS

The FIR load impedance magnitude and phase limits at the UIP interface is defined in Figure 3.2.5.1–1.

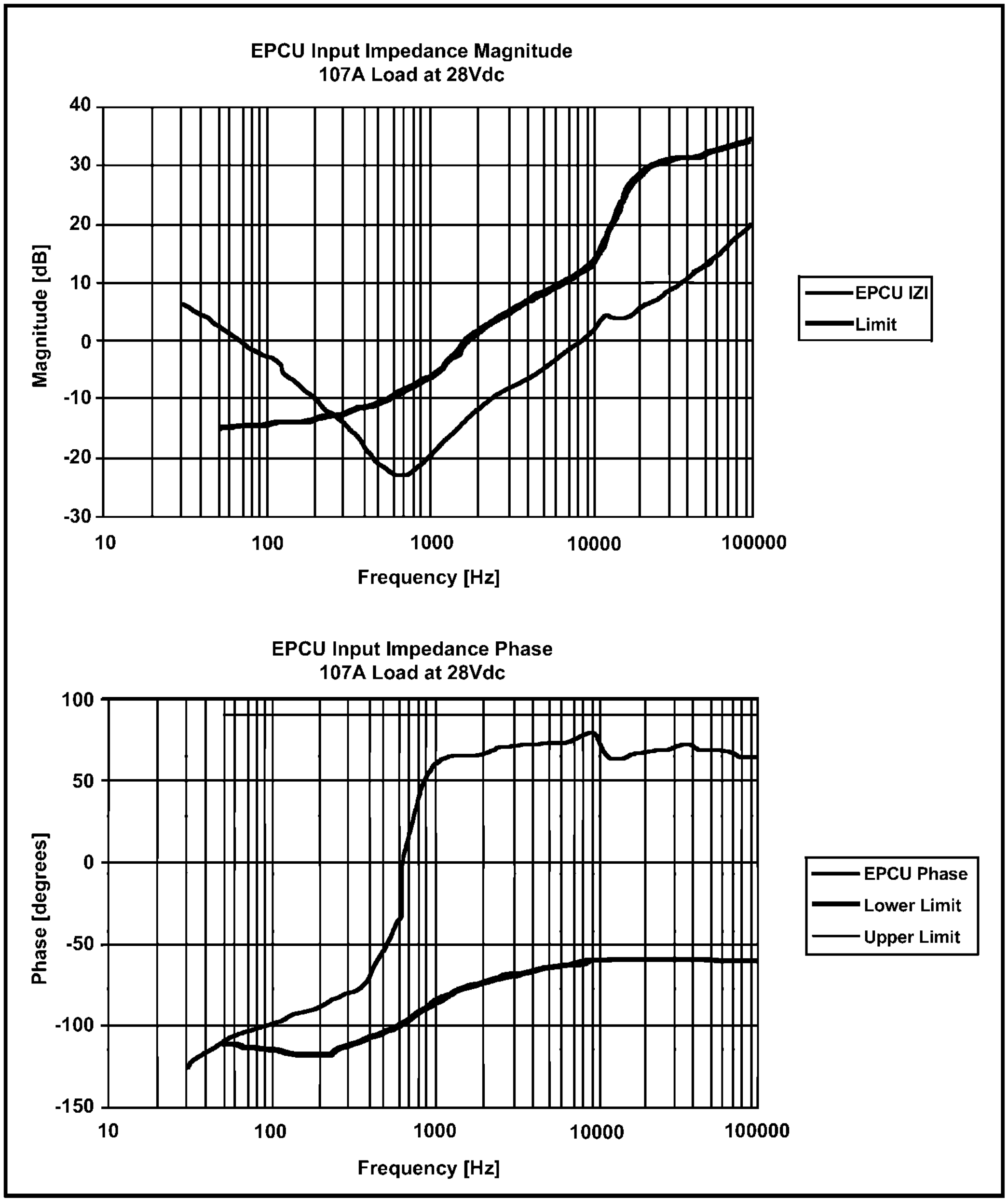
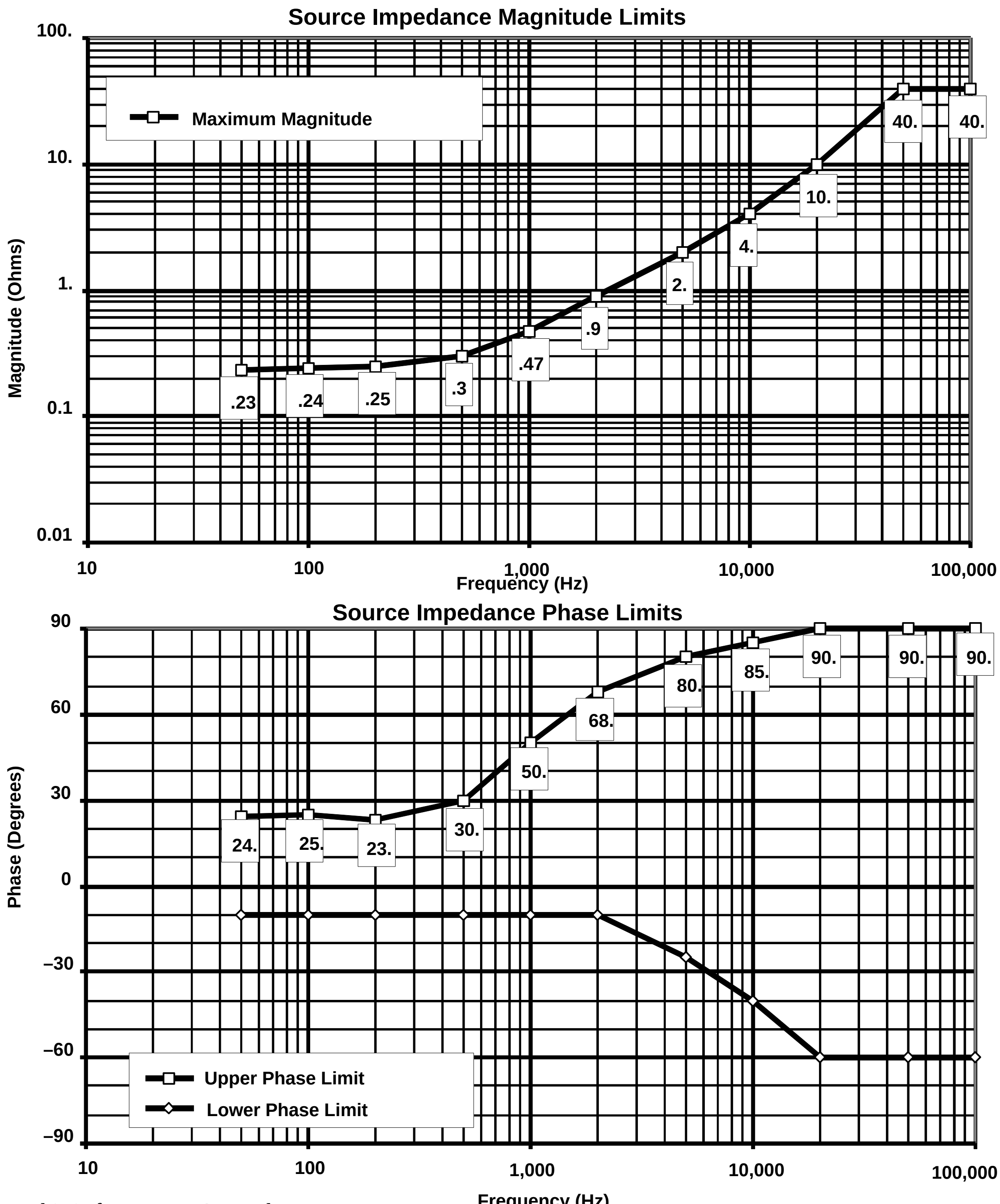


FIGURE 3.2.5.1–1 FIR LOAD IMPEDANCE

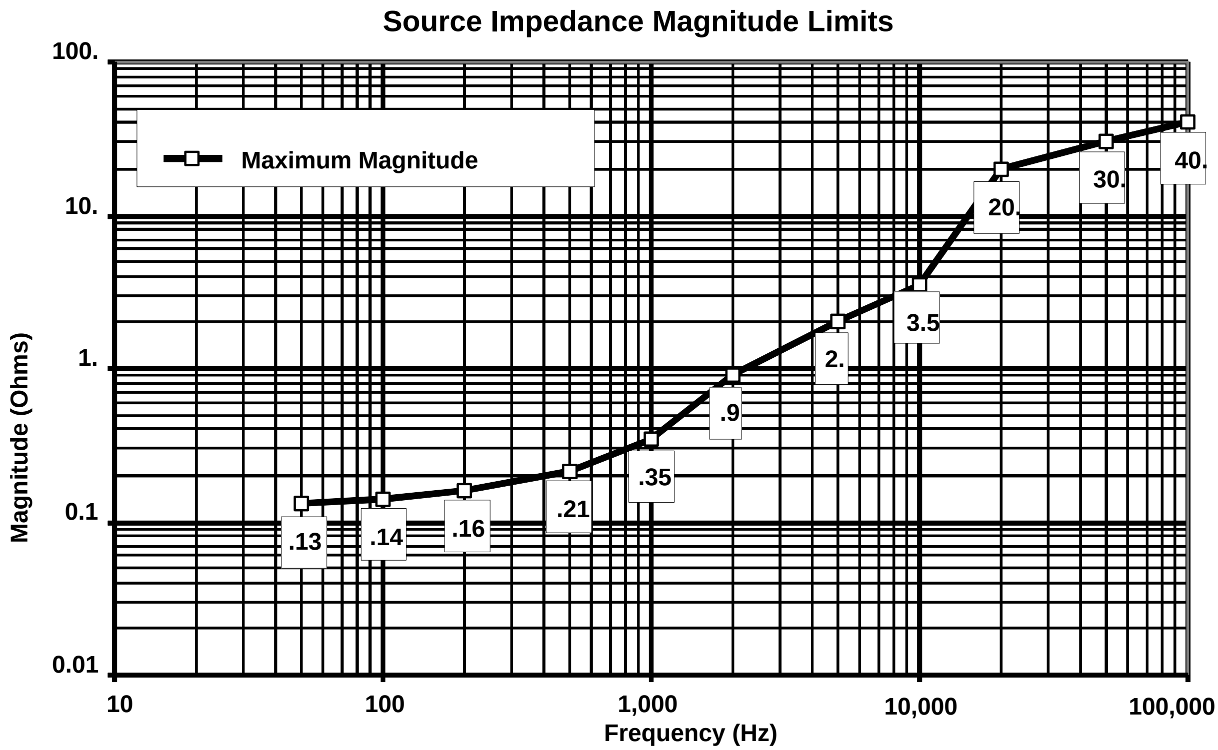
3.2.5.2 SOURCE IMPEDANCE LIMITS

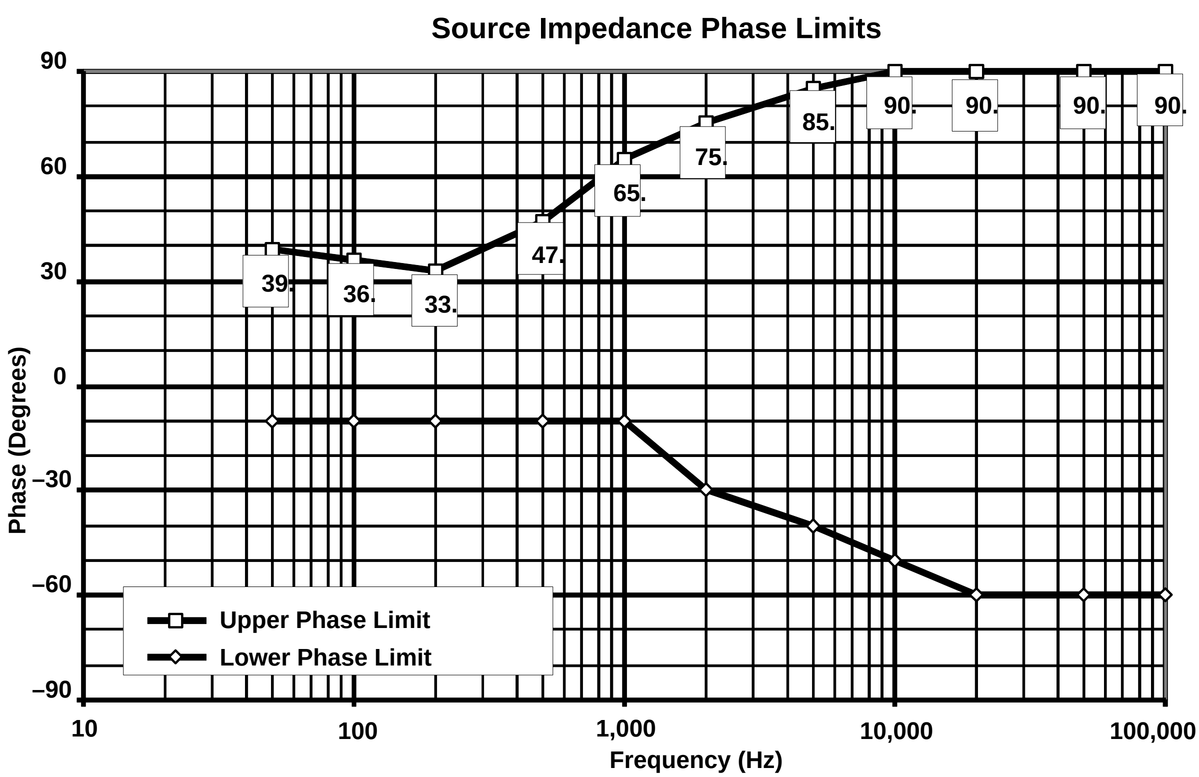
The source impedance at UIP locations, except MPLM rack locations, will meet the limits as shown in Figures 3.2.5.2–1, 3.2.5.2–2 and 3.2.5.2–3.



Note: This is for one DDCU as the source.

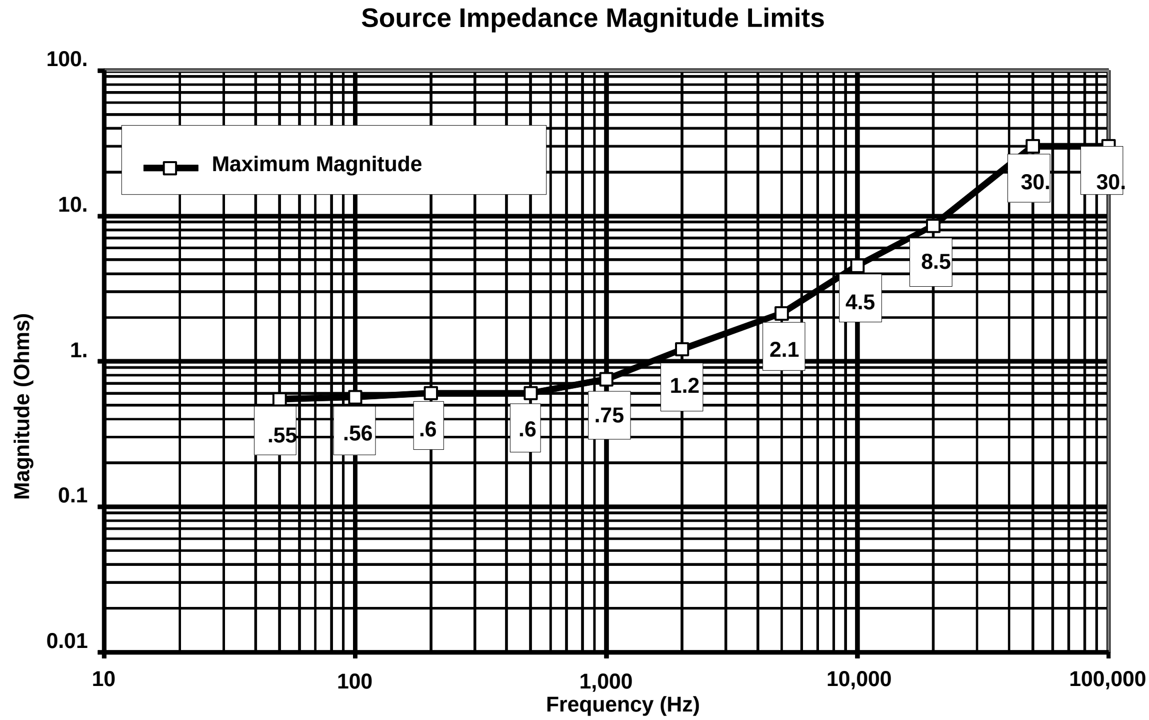
FIGURE 3.2.5.2–1 3 kW INTERFACE POWER SOURCE IMPEDANCE LIMITS

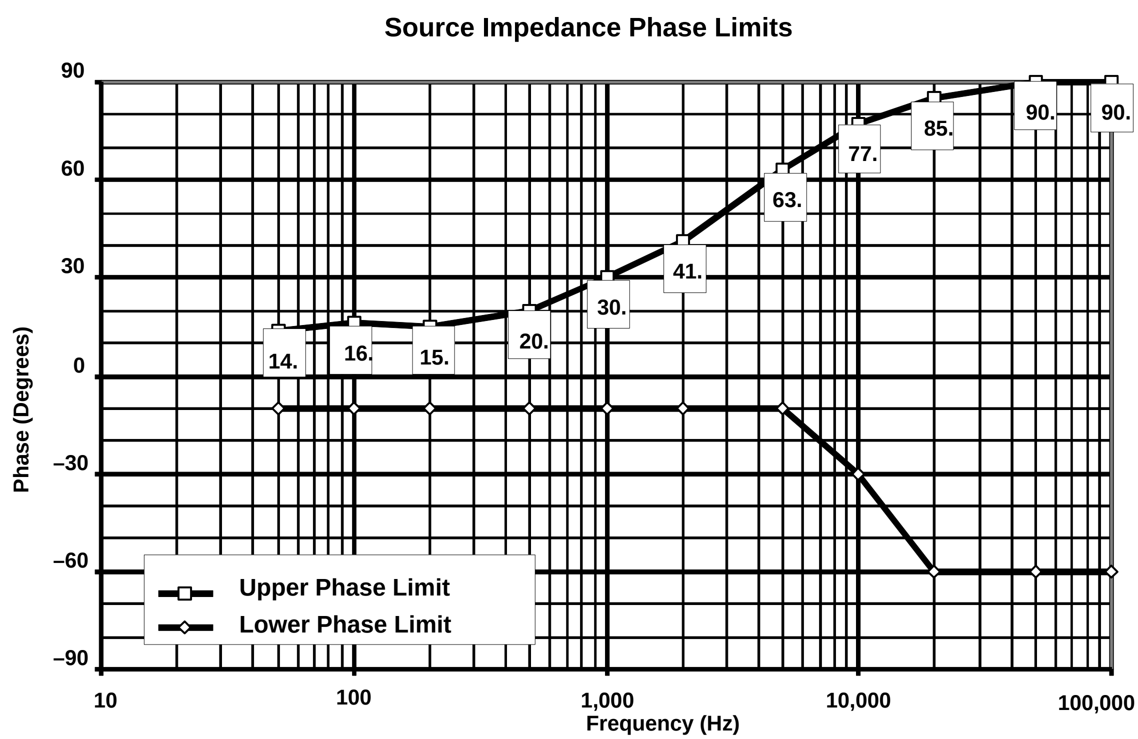




Note: This is for one DDCU as the source.

FIGURE 3.2.5.2–2 6 kW INTERFACE B POWER SOURCE IMPEDANCE LIMITS





Note: This is for one DDCU as the source.

FIGURE 3.2.5.2–3 1.2 – 1.44 kW INTERFACE B POWER SOURCE IMPEDANCE LIMITS

3.2.6 REMOTE POWER CONTROLLER OVERLOAD LIMITS

The overload protection characteristics of the FIR power distribution and circuit protection system is illustrated in Figure 3.2.6–1.

The ISS power source will provide protection to the FIR interface for ISPR overload conditions by means of a Remote Power Controller (RPC).

The overload limitation characteristics of the power feeders are defined in Figure 3.2.6–2. The curve defines the region for RPCs connected to ISPR locations in the USL and MPLM.

For current limiting switches, the shaded regions in the figures show the current limit regions from the time the protection devices start to control the current within the specified range, to the maximum time where the protection device trips and interrupts the current flow. For non–current limiting switches, the shaded regions in the figure show the range of the over–current threshold from minimum trip decision time, to the maximum trip decision time.

Table 3.2.6–1 defines the characteristics of the RPCs.

USL: ISPR locations are connected to non–current limiting RPCs for 3 and 6 kW feeds, and to current limiting RPCs for 1.44 kW (Auxiliary) feeds. Nominal current ratings are 25, 50, and 12 amperes respectively.

For the non–current limiting RPCs:

– A feeder current above the threshold at 500%–600% of nominal rating for 0 to 10 microseconds will cause the RPC to trip

– A feeder current above the threshold at 190%–210% of nominal rating for 1 to 2 milliseconds will cause the RPC to trip.

– A feeder current above the threshold at 110%–120% of nominal rating for 40 to 48 milliseconds will cause the RPC to trip.

For the current limiting RPCs on the 1.44 kW feeds:

– The current will be controlled to within the limiting level of 13.2 to 14.4 amperes within 1 millisecond. The RPC will trip if the current remains in the limiting region up to the decision time of 34.5 ± 3.5 milliseconds.

(TBD #6)

FIGURE 3.2.6–1 FIR OVERLOAD PROTECTION CHARACTERISTICS

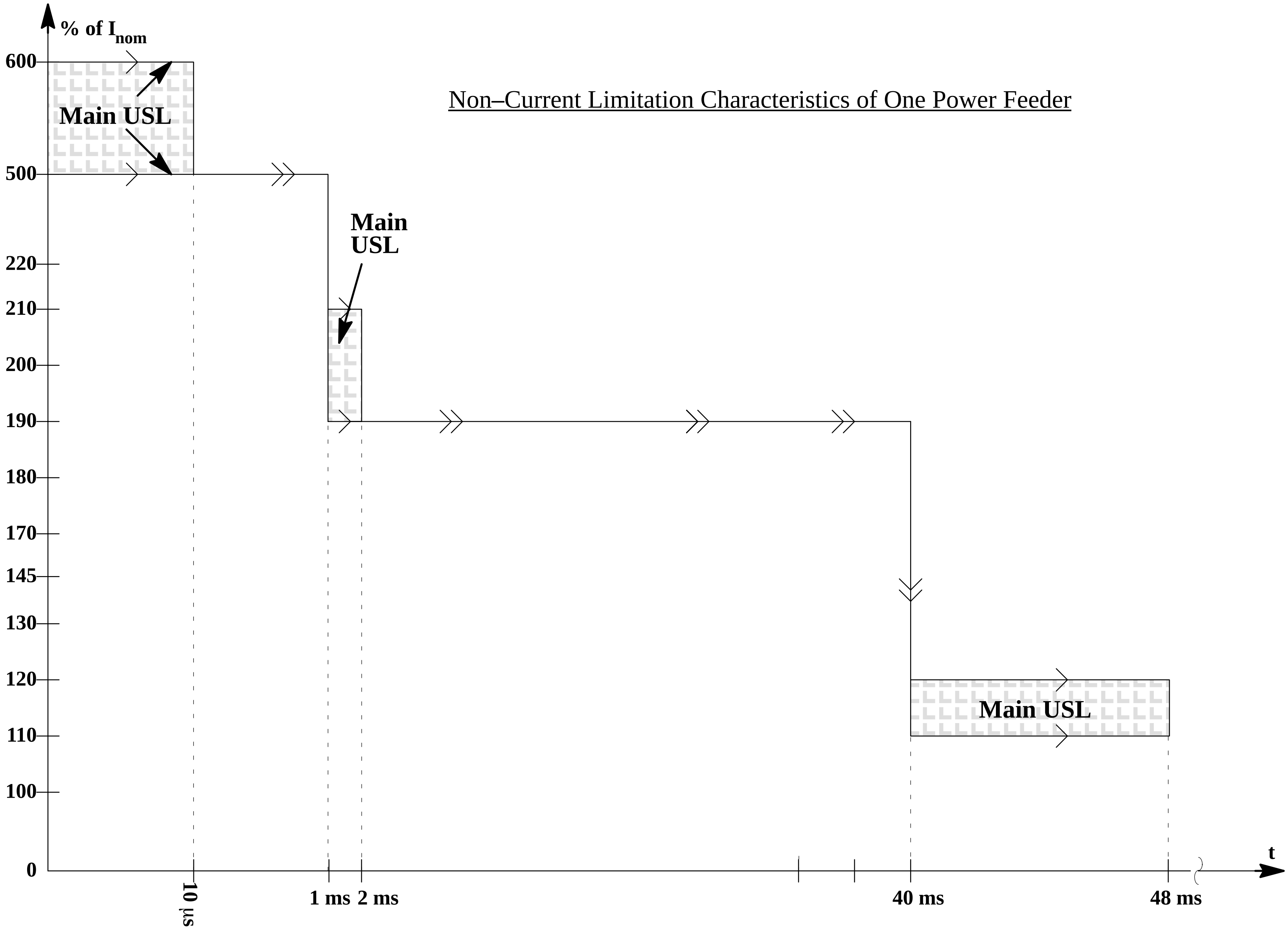


FIGURE 3.2.6–2 USL OVERLOAD PROTECTION CHARACTERISTICS

TABLE 3.2.6–1 DETAILED UPSTREAM PROTECTION CHARACTERISTICS

PWR INTERFACE	MAIN PWR FEEDER				
	CURRENT LIMITATION LEVEL		MINIMUM TRIP THRESHOLD	TRIP DECISION TIME (1)	
	MIN.	MAX		MIN.	MAX.
3 kW ISPR USL	N/A	N/A	27.5 A	40 ms	48 ms
6 kW ISPR USL	N/A	N/A	55.0 A	40 ms	48 ms
12 kW ISPR USL FEED A/BUS 1 FEED B/BUS 2	N/A N/A	N/A N/A	55.0 A 55.0 A	40 ms 40 ms	48 ms 48 ms

PWR INTERFACE	AUX PWR FEEDER				
	NOM. POWER	CURRENT LIMITATION LEVEL		TRIP DECISION TIME (1)	
		MIN.	MAX	MIN.	MAX.
ISPR USL	1.44kW	13.2A	14.4 A	31 ms	38 ms

Note:
1) Trip decision time within range of minimum and maximum limiting/trip threshold.

3.2.7 ELECTRICAL POWER CONSUMING EQUIPMENT (EPCE) INTERFACE WITH THE UIP OR UOP

The FIR power consumption and current draw is defined in Table 3.2.7–1. The surge current for the FIR is illustrated in Figure 3.2.7–1. An electrical schematic of the FIR is provided in Figure 3.2.7–2.

TABLE 3.2.7–1 FIR POWER CHARACTERISTICS

On–Orbit	POWER (WATTS) MAIN FEED			P/L Characteristics	CURRENT (Amps) MAIN FEED		POWER (WATTS) AUXILIARY FEED			CURRENT (Amps) AUXILIARY FEED	
	Peak	Max Cont	Keep Alive		Peak	Max Cont	Peak	Max Cont	Keep Alive/	Peak	Max Cont
Start–up/ Health Check	**(TBD #7)**			–							
Environment Preparation				–							
Experiment Operation				–							
Data Processing				–							
Downlink				–							

Note: The FIR EPCU is designed to allow the use of power from both the Main and Auxiliary buses simultaneously to meet the FIR power requirements if power channelization analysis determines that the FIR power requirements cannot be met by a single bus.

Peak Power is defined as the highest power requirement lasting greater than 50 msec.

(TBD #8)

FIGURE 3.2.7–1 FIR SURGE CURRENT

(TBD #9)

FIGURE 3.2.7–2 ELECTRICAL SCHEMATIC OF THE FIR OR ELECTRICAL POWER CONSUMING EQUIPMENT INTERFACING TO THE UIP

Note: Rack Integrator and/or payload developer will provide a detailed electrical schematic that includes, but is not limited to, wire gauge, circuit protection devices, integrated rack power removal switch, GFCI, portable equipment power cords, isolation resistance between main and auxiliary feeds, electrical grounding scheme, etc. Filtered schematics are to be supplied including component values and minimum component resistance (for estimation of Q related effects). Qualified aerospace enclosures are to be identified if reduced size wiring or parallel wiring is used.

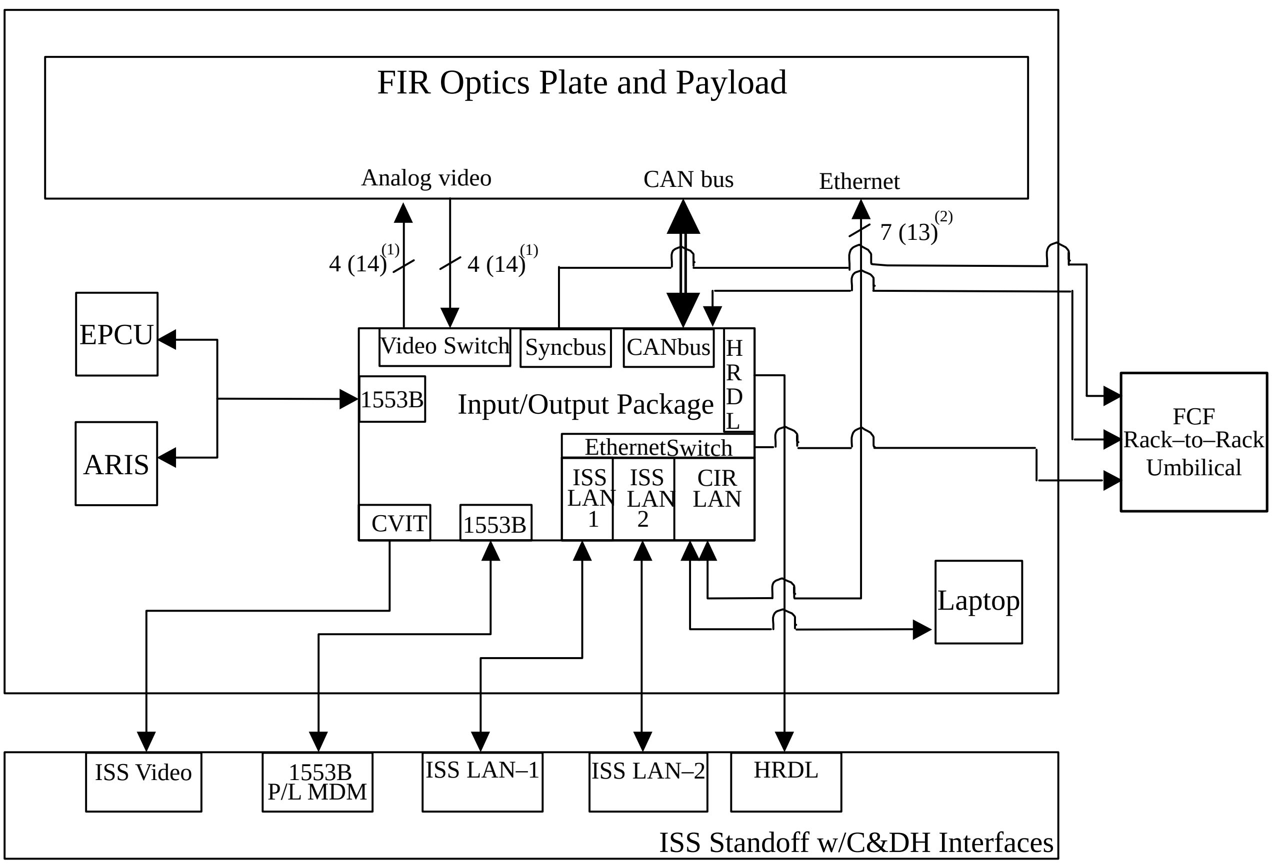
3.3 COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS

This section applies to all payload commands and data on the Low Rate Data Link (LRDL), Medium Rate Data Link (MRDL), and High Rate Data Link (HRDL) and MDM supported analog and discrete measurements, including those necessary to interface with the Fire Detection and Suppression System.

3.3.1 GENERAL REQUIREMENTS

The following sections contain descriptions of the unique characteristics of rack data links. The combination of Integrated Data Flow Schematics and details provided in subsequent sections define routing, switching and electrical characteristics as required to perform payload operations and to support link level analysis, test and troubleshooting. FIR internal connectors and cables which require crew interaction for installation or on–orbit operation are also defined by location, connector pin function.

The Integrated Data Flow Schematic for the FIR is provided in Figure 3.3.1–1.



(1) Channels in use with 4 IPSUs (Total Channels Available)
(2) Ports in use with 4 IPSUs (Total Ports Available)

FIGURE 3.3.1–1 INTEGRATED DATA FLOW SCHEMATIC

3.3.2 STANDARD PAYLOAD 1553B LOW RATE DATA LINK

The LRDL electrical interfaces will be in accordance with MIL–STD–1553B, using the interconnection requirements as specified in SSQ 26678, paragraph 4.5.1.1.

3.3.2.1 ELECTRICAL INTERFACE

The FIR internal wiring stub length, as defined in MIL–STD–1553B, is listed in Table 3.3.2.1–1.

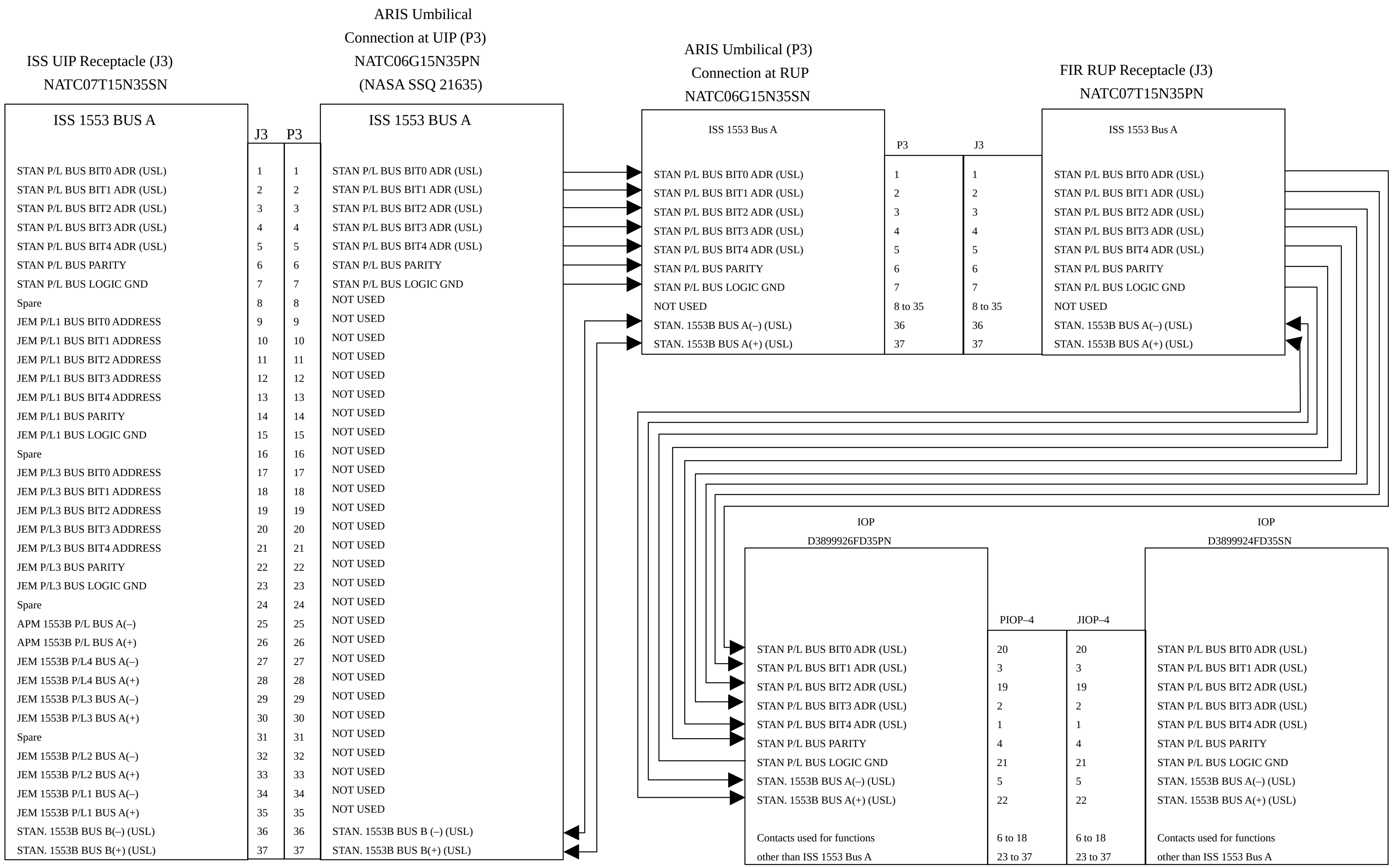
TABLE 3.3.2.1–1 FIR LRDL ELECTRICAL CHARACTERISTICS

	Recommended	Actual
Type	Twisted Shielded	
*** Stub Length**	≤ 12 Feet	**(TBD #10)**
***** Measured from the RT to the ISPR Utility Interface Panel		

3.3.2.2 CONNECTORS

The FIR 1553B bus connectors to the UIP, J3 and J4, pin assignments are shown in Figures 3.3.2.2–1 and 3.3.2.2–2, respectively. The MIL–STD–1553B bus connectors are defined in Table 3.1.2–1.

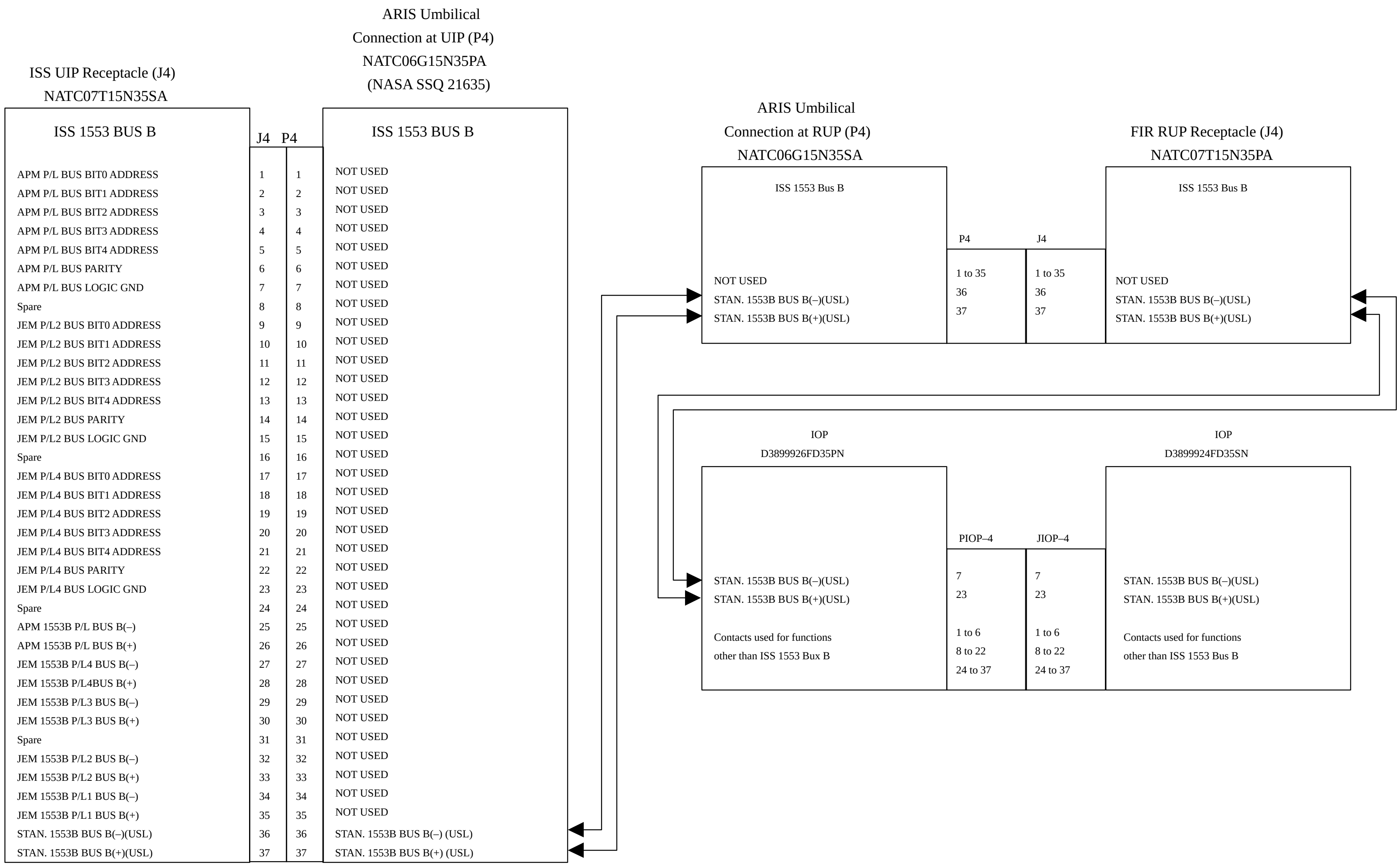
The integrated rack 1553B bus connectors to the UOP, J3 and J4, pin assignments are not applicable to the FIR.



NOTE: Data buses are controlled impedance twisted shielded pairs with the shield terminated on the connector backshell.

NOTE: The bus address logic ground shall be connected to the ISPR Remote Terminal chassis ground.

FIGURE 3.3.2.2–1 PAYLOAD 1553B BUS A CONNECTOR PIN / ASSIGNMENT – J3



NOTE: Data buses are controlled impedance twisted shielded pairs with the shield terminated on the connector backshell.

NOTE: The bus address logic ground will be connected to the ISPR Remote Terminal chassis ground.

FIGURE 3.3.2.2–2 PAYLOAD 1553B BUS B CONNECTOR / PIN ASSIGNMENT – J4

3.3.3 MEDIUM RATE DATA LINK (MRDL)

3.3.3.1 CONNECTORS

The FIR MRDL connectors, J46 and J47, pin assignments are shown in Figures 3.3.3.1–1 and 3.3.3.1–2, respectively. The ISS Payload MRDL Architecture is shown in Figure 3.3.3.1–3. The MRDL connectors are defined in Table 3.1.2–1.

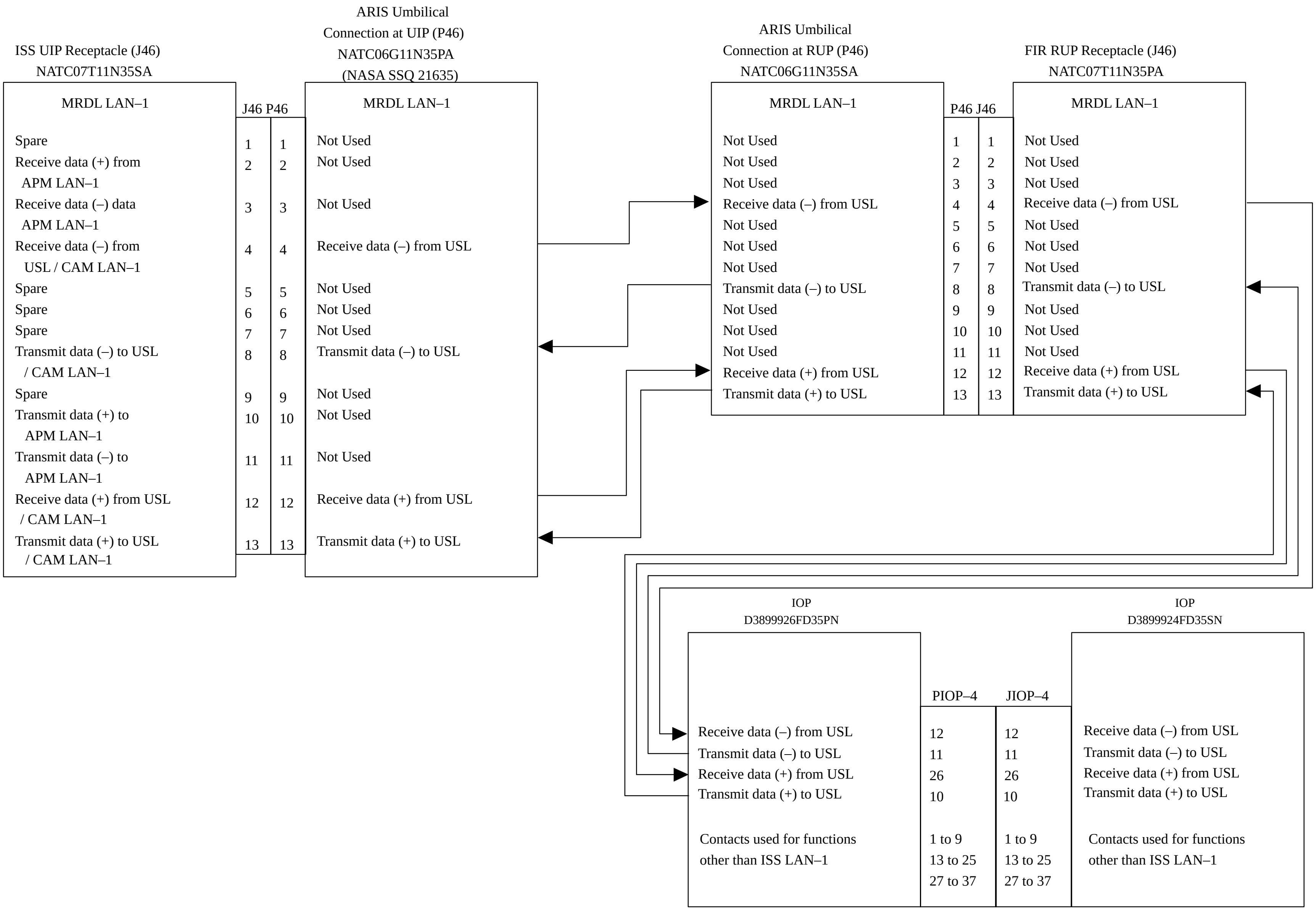


FIGURE 3.3.3.1–1 USL LAN–1 INTERFACE CONNECTOR / PIN ASSIGNMENT – J46

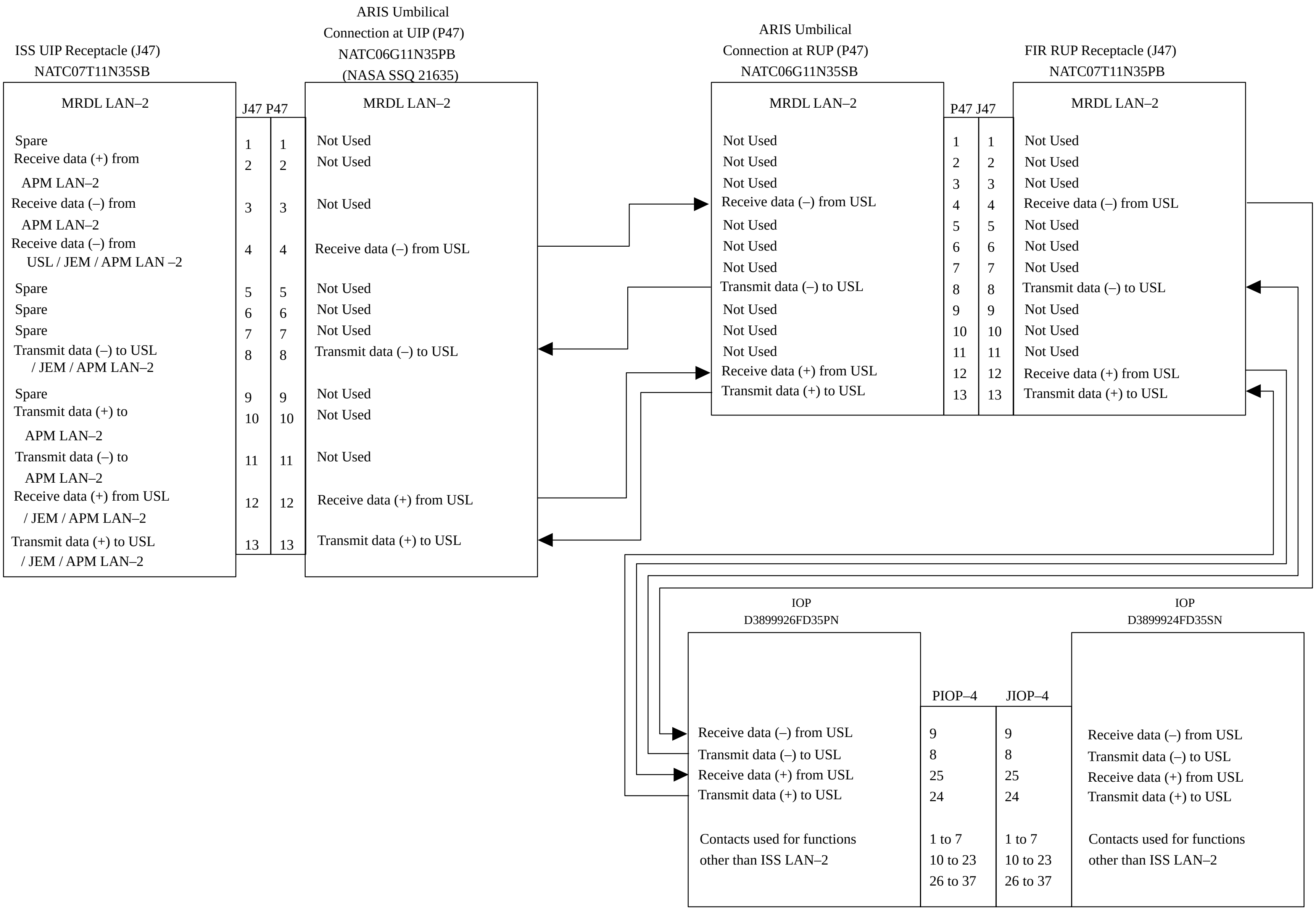


FIGURE 3.3.3.1–2 USL LAN–2 INTERFACE CONNECTOR / PIN ASSIGNMENT – J47

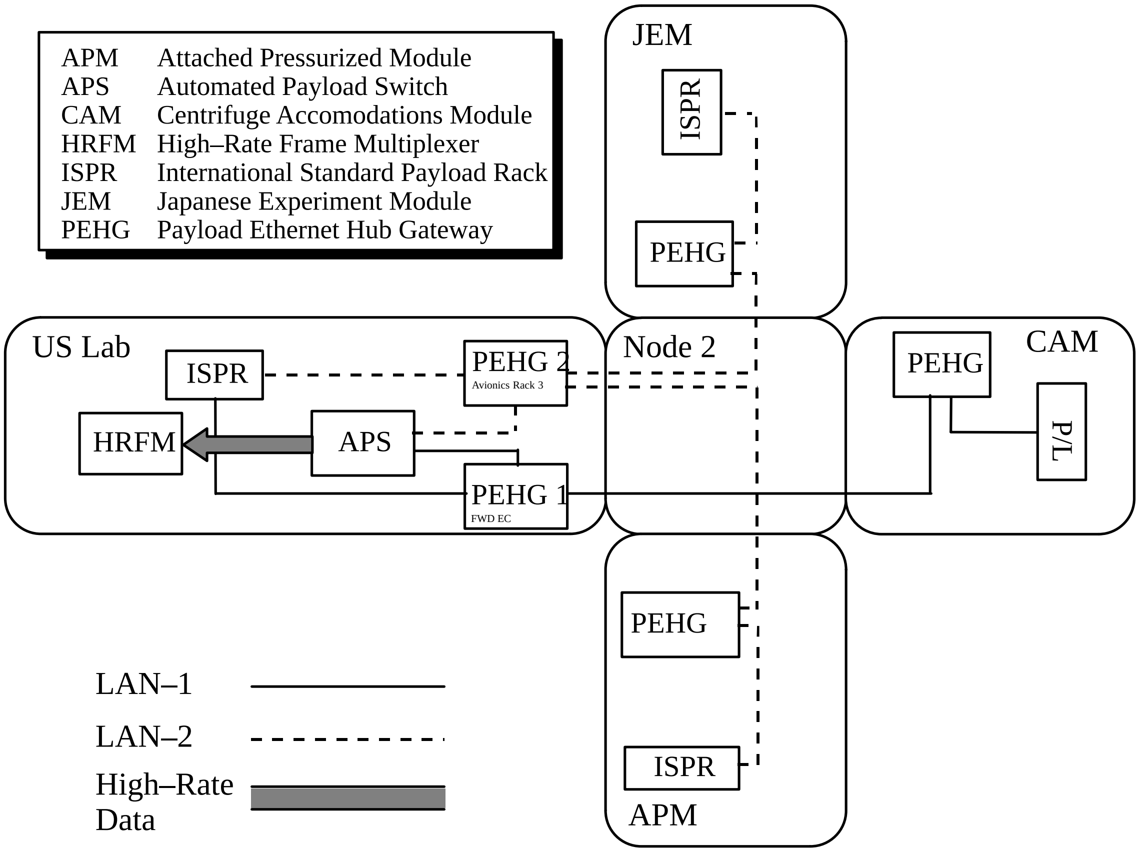


FIGURE 3.3.3.1–3 ISS PAYLOAD MRDL ARCHITECTURE

3.3.3.2 ELECTRICAL INTERFACE

The FIR internal MRDL wiring stub length is listed in Table 3.3.3.2–1.

TABLE 3.3.3.2–1 FIR MRDL WIRING STUB LENGTH

	Recommended	Actual
Type	Twisted Shielded	
Cable Length	≤ 16.4 feet	**(TBD #11)**

3.3.4 HIGH RATE DATA LINK (HRDL)

3.3.4.1 CONNECTOR

The FIR HRDL connector, J7, pin assignments are shown in Figure 3.3.4.1–1. The HRDL bus connector is defined in Table 3.1.2–1.

3.3.4.2 FIBER OPTIC SIGNAL CHARACTERISTICS

The FIR Fiber Optic signal power at the HRDL J7 interface is: **(TBD #12)** dBm.

3.3.5 FDS / MAINTENANCE (POWER) SWITCH INTERFACE

3.3.5.1 CONNECTOR

The FIR fire detection support and Rack Maintenance (rack power) switch signals connector, J43, pin assignments are shown in Figure 3.3.5.1–1. The fire detection support and power removal switch connector is defined in Table 3.1.2–1.

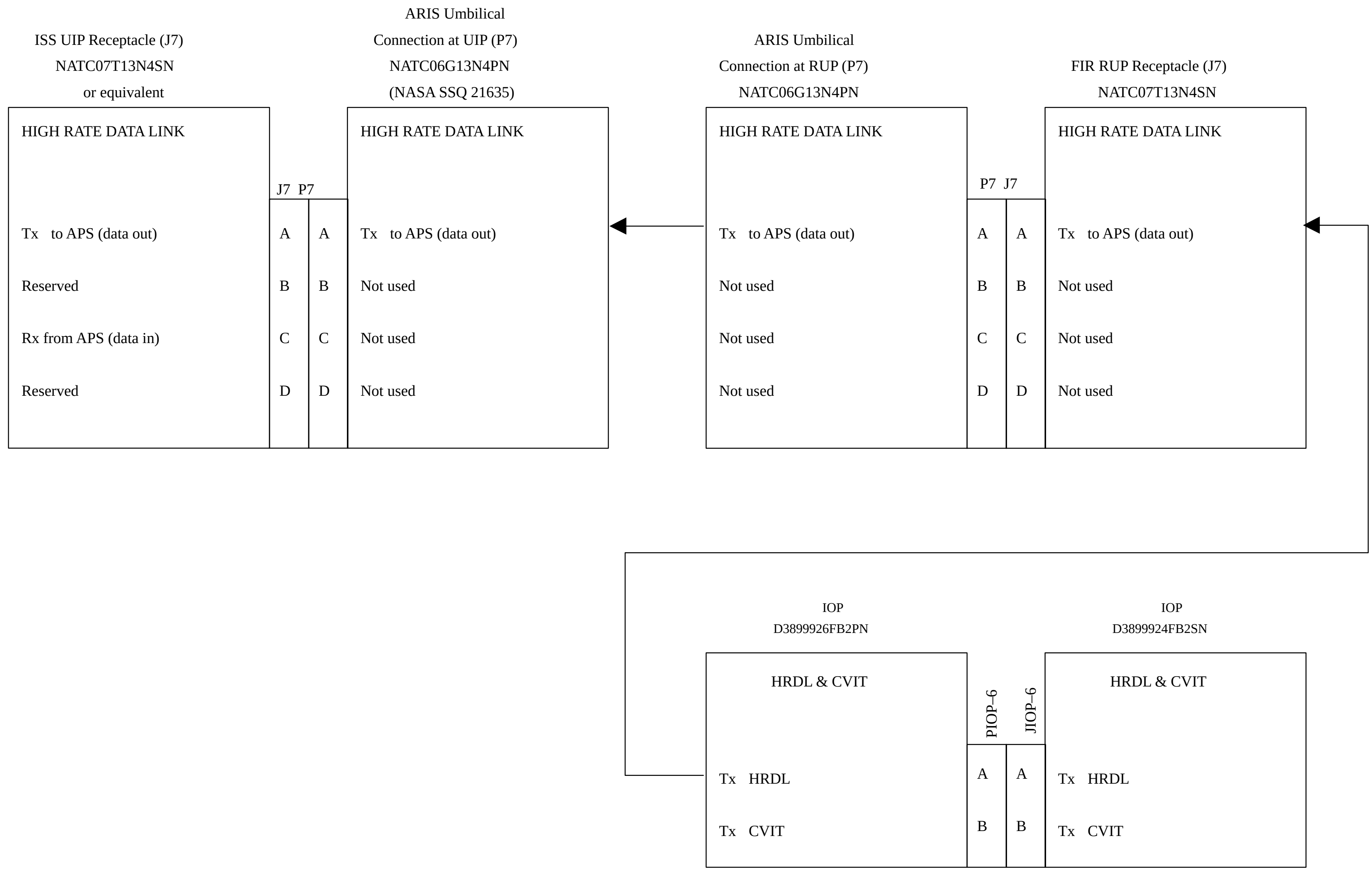


FIGURE 3.3.4.1–1 STANDARD HIGH RATE DATA CONNECTOR PART NUMBER AND PIN ASSIGNMENT – J7

UIP				RUP			
ISS UIP Receptacle (J1)			ARIS Umbilical Connection at UIP (P43)	ARIS Umbilical Connection at RUP (P43)			FIR RUP Receptacle (J43)
NATC07T13N35SA			NATC06G13N35PA	NATC06G13N35SA			NATC07T13N35PA
MAINT. SWITCH / FIRE DETECTION SUPPORT INTERFACE	J43	P43	MAINT. SWITCH / FIRE DETECTION SUPPORT INTERFACE	MAINT. SWITCH / FIRE DETECTION SUPPORT INTERFACE	J43	P43	MAINT. SWITCH / FIRE DETECTION SUPPORT INTERFACE
Smoke Detection Scatter (–)	1	1	Smoke Detection Scatter (–)	Smoke Detection Scatter (–)	1	1	Smoke Detection Scatter (–)
Spare	2	2	Not Used	Spare	2	2	Not Used
Spare	3	3	Not Used	Spare	3	3	Not Used
Spare	4	4	Not Used	Spare	4	4	Not Used
Spare	5	5	Not Used	Spare	5	5	Not Used
Spare	6	6	Not Used	Spare	6	6	Not Used
Spare	7	7	Not Used	Spare	7	7	Not Used
Spare	8	8	Not Used	Spare	8	8	Not Used
Spare	9	9	Not Used	Spare	9	9	Not Used
Spare	10	10	Not Used	Spare	10	10	Not Used
Spare	11	11	Not Used	Spare	11	11	Not Used
Fan Ventilation Indicator (+)	12	12	Fan Ventilation Indicator (+)	Fan Ventilation Indicator (+)	12	12	Fan Ventilation Indicator (+)
Fan Ventilation Indicator (–)	13	13	Fan Ventilation Indicator (–)	Fan Ventilation Indicator (–)	13	13	Fan Ventilation Indicator (–)
Smoke Detection Scatter (+)	14	14	Smoke Detection Scatter (+)	Smoke Detection Scatter (+)	14	14	Smoke Detection Scatter (+)
Smoke Indicator Command (–)	15	15	Smoke Indicator Command (–)	Smoke Indicator Command (–)	15	15	Smoke Indicator Command (–)
Smoke Detection Obscuration (+)	16	16	Smoke Detection Obscuration (+)	Smoke Detection Obscuration (+)	16	16	Smoke Detection Obscuration (+)
Smoke Detection Obscuration (–)	17	17	Smoke Detection Obscuration (–)	Smoke Detection Obscuration (–)	17	17	Smoke Detection Obscuration (–)
Smoke Detection Bit Enable (–)	18	18	Smoke Detection Obscuration (–)	Smoke Detection Bit Enable (–)	18	18	Smoke Detection Obscuration (–)
Power Removal Switch Position	19	19	Power Removal Switch Position	Power Removal Switch Position	19	19	Power Removal Switch Position
Power Removal Switch Position	20	20	Power Removal Switch Position	Power Removal Switch Position	20	20	Power Removal Switch Position
Smoke Indicator Command (+)	21	21	Smoke Indicator Command (+)	Smoke Indicator Command (+)	21	21	Smoke Indicator Command (+)
Smoke Detection Bit Enable (+)	22	22	Smoke Detection Bit Enable (+)	Smoke Detection Bit Enable (+)	22	22	Smoke Detection Bit Enable (+)

FIGURE 3.3.5.1–1 FIR POWER REMOVAL SWITCH / FIRE DETECTION SUPPORT INTERFACE CONNECTOR / PIN ASSIGNMENTS – J43

3.3.5.2 SMOKE SENSOR CIRCUIT CHARACTERISTICS

The interface for the FIR smoke detector is as depicted in the simplified schematic of Figure 3.3.5.2–1. FIR smoke detector functional characteristics are shown in Table 3.3.5.2–1.

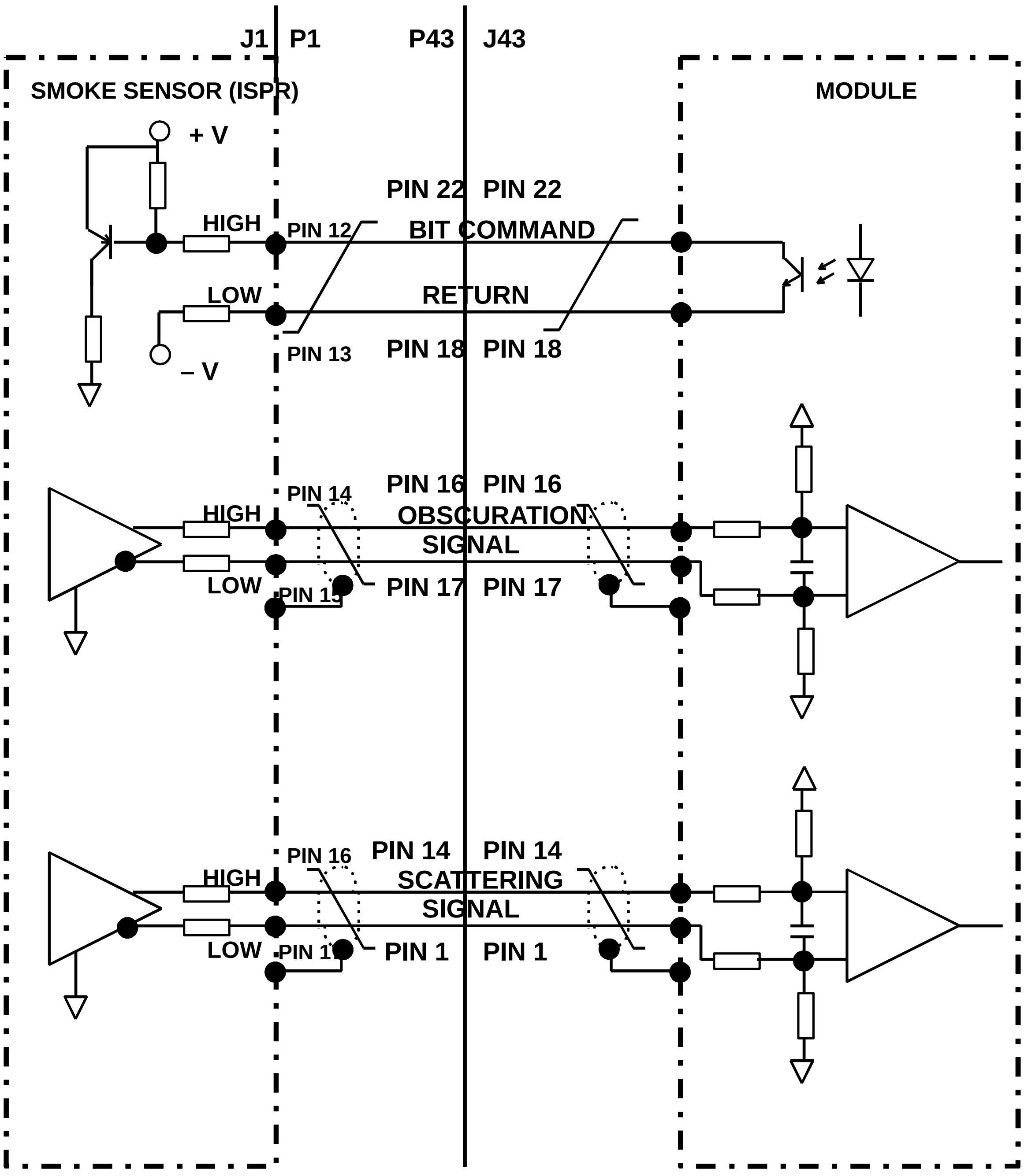


FIGURE 3.3.5.2–1 PRINCIPLE CIRCUIT FOR THE SMOKE SENSOR INTERFACE

TABLE 3.3.5.2–1 SMOKE DETECTION SUPPORT FUNCTIONAL CHARACTERISTICS

TYPE	SIGNAL NAME	SIGNAL TYPE	CONDITION	SIGNAL RANGE	VOLTAGE RANGE (SIGNAL RANGE) NOMINAL
Smoke Detector	BIT input	Discrete	Nominal	Open (high)	V= +5.0 Vdc
Smoke Detector	BIT input	Discrete	BIT ON	Closed (low)	V< +5.0 Vdc
Smoke Detector	Obscuration Output	Analog	Nominal	0 to 100% light attenuation	V= +4 to -4 Vdc
Smoke Detector	Obscuration Output	Analog	BIT ON	Laser OFF	V< -3.8 Vdc
Smoke Detector	Scatter output	Analog	Nominal	0 to 2% OBS/ ft	0 to 4.5 Vdc
Smoke Detector	Scatter output	Analog	BIT ON	0.9 to 2.1 % OBS/ ft	1.8 to 4.2 Vdc
Smoke Detector	Scatter output	Analog	BIT Off (Quiet Period)	0% OBS/ ft	0 to 0.5 Vdc
FAN Ventilation	Ventilation output	Analog	Nominal	+/ - 5 Vdc	+/ - 5 Vdc
Smoke Indicator	Indication input	Discrete	N/ A	N/ A	N/ A

The rack air flow threshold voltage for smoke–detection is: **(TBD #13)** Vdc.

The circuit diagram for the fan and smoke indicator LED is shown in Figure 3.3.5.2–2.

(TBD #14)

FIGURE 3.3.5.2–2 FAN AND SMOKE INDICATOR LED CIRCUIT

3.3.5.3 RACK MAINTENANCE (POWER) SWITCH CIRCUIT CHARACTERISTICS

The USL provides, at each ISPR location, one switch closure command line for switching off the main/auxiliary power feeds implemented at the J43 connector. The interface for the Rack Maintenance Switch is depicted in the simplified schematic in Figure 3.3.5.3–1.

A closed switch will cause power to be removed from the FIR. The power cannot be re–applied to the FIR unless the switch will be returned to the closed position.

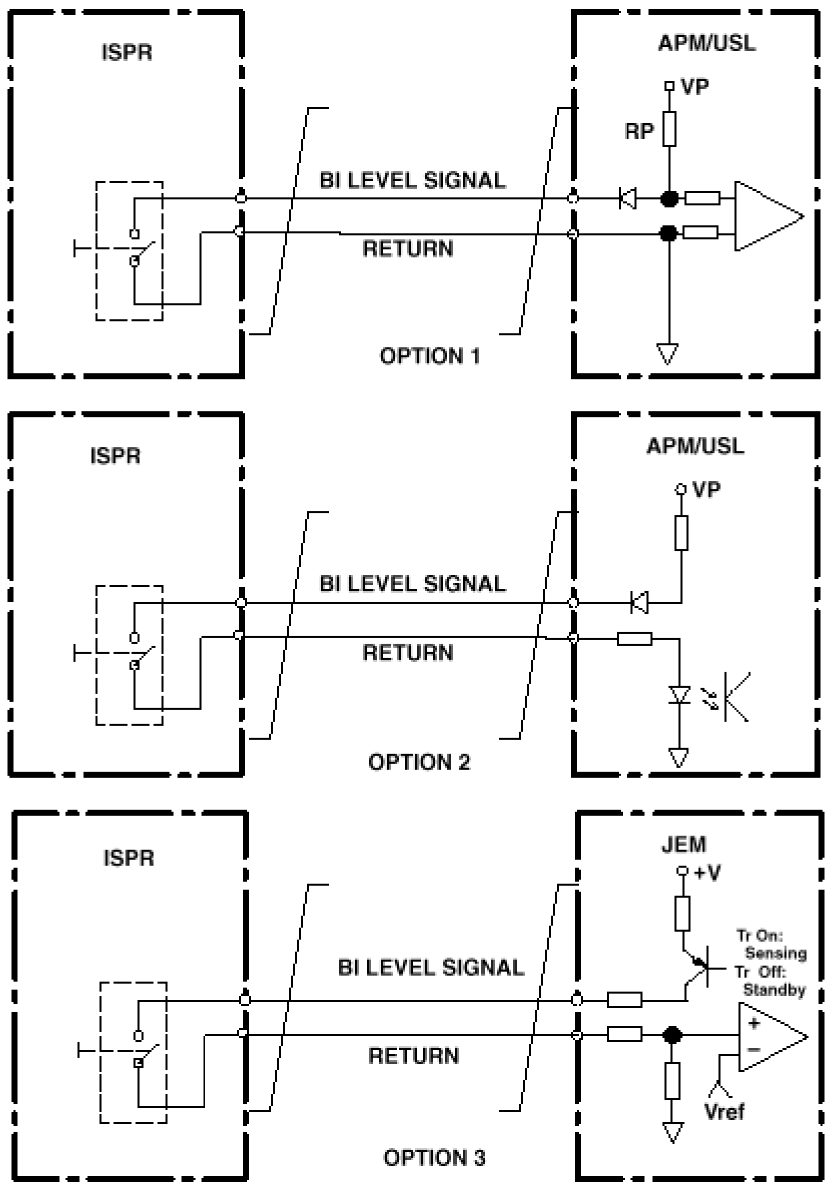


FIGURE 3.3.5.3–1 RACK MAINTENANCE SWITCH INTERFACE

3.4 PAYLOAD VIDEO INTERFACE REQUIREMENTS

This section is limited to internal video interfaces. The USL provides a fiber optic video interface. The MPLM does not have video.

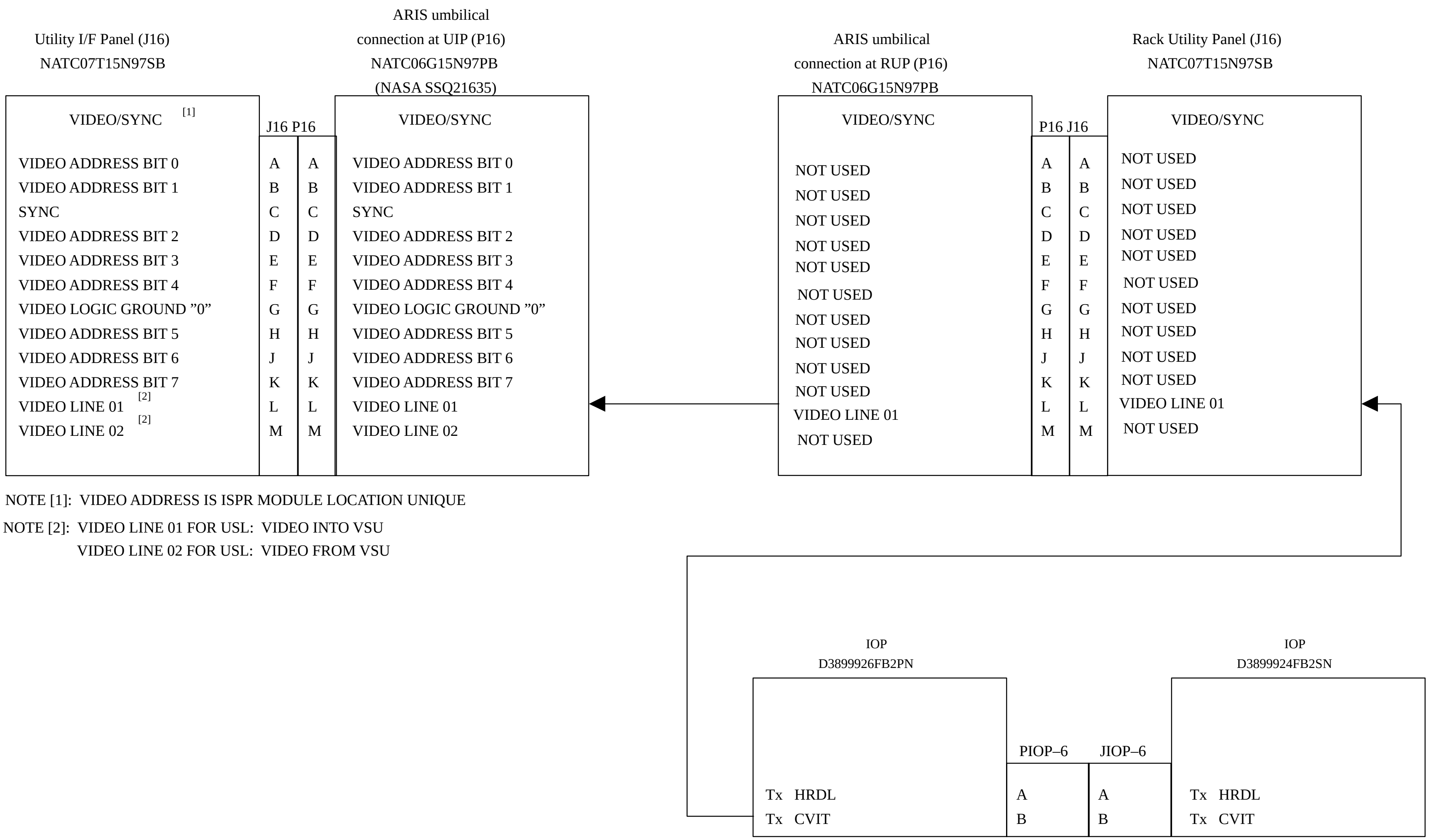
3.4.1 NTSC FIBER OPTIC VIDEO

3.4.1.1 PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS

The Pulse Frequency Modulation (PFM) fiber optical video interface consists of one video channel into the rack, one video channel out of the rack, and one synchronization and control channel.

3.4.1.2 PFM NTSC OPTICAL CONNECTOR

The FIR PFM NTSC video optical connector, J16 pin assignments are shown in Figure 3.4.1.2–1. The location of the video optical connector, J16, interface at the UIP is defined in Figures 3.1.2–1 and 3.1.2–2. The video optical connector is defined in Table 3.1.2–1.



NOTE [1]: VIDEO ADDRESS IS ISPR MODULE LOCATION UNIQUE

NOTE [2]: VIDEO LINE 01 FOR USL: VIDEO INTO VSU
VIDEO LINE 02 FOR USL: VIDEO FROM VSU

FIGURE 3.4.1.2–1 OPTICAL VIDEO CONNECTOR / PIN ASSIGNMENT – J16

3.4.2 NTSC ELECTRICAL VIDEO INTERFACES

The FIR does not utilize JEM interfaces; thus the electrical video interfaces do not apply.

3.5 THERMAL CONTROL INTERFACE REQUIREMENTS

3.5.1 INTERNAL THERMAL CONTROL SYSTEM (ITCS) INTERFACE REQUIREMENTS

3.5.1.1 CONNECTOR

The location of the ITCS Moderate Temperature Loop (MTL) interfaces at the UIP are defined in Figures 3.1.2–1 and 3.1.2–2. The MTL connectors are defined in Table 3.1.2–1. The FIR does not utilize the LTL interfaces.

3.5.1.2 ITCS COOLANT FLOW RATE AND PRESSURE DROP

The FIR can request to be supplied a specific flow rate within the ranges specified in Table 3.5.1.2–1. Multiple flow rate settings can be accommodated, provided the control system time constant requirements are met and the flow rate setting changes are properly coordinated with the Module Integrator. During nominal operations, the FIR should receive ITCS coolant from the interface at maximum flow. The FIR contains two ITCS flow control devices, the Water Flow Control Assembly (WFCA), used in conjunction with the ISS Rack Flow Control Assembly (RFCA). Each WFCA is capable of controlling the flow of coolant through the FIR within the range of 25 to 300 ± 3 lbm/hr. A schematic of the FIR coolant loop is provided in Figure 3.5.1.2–1. The maximum pressure drop across the FIR for the MTL is defined in Figure 3.5.1.2–2. The coolant flow rate required by the FIR and the corresponding pressure drop across the rack is defined in Figure 3.5.1.2–3.

TABLE 3.5.1.2–1 ITCS SELECTABLE COOLANT FLOW RATES

Loop/Lab	USL [1] lbm/hr (kg/hr)	FIR lbm/hr (kg/hr)
MTL w/RFCA	100 – 745 (45 – 339)	300 (136)

Note: [1] The integrated rack return temperature design point will be greater than or equal to a delta T of 35 degrees F for the MTL.

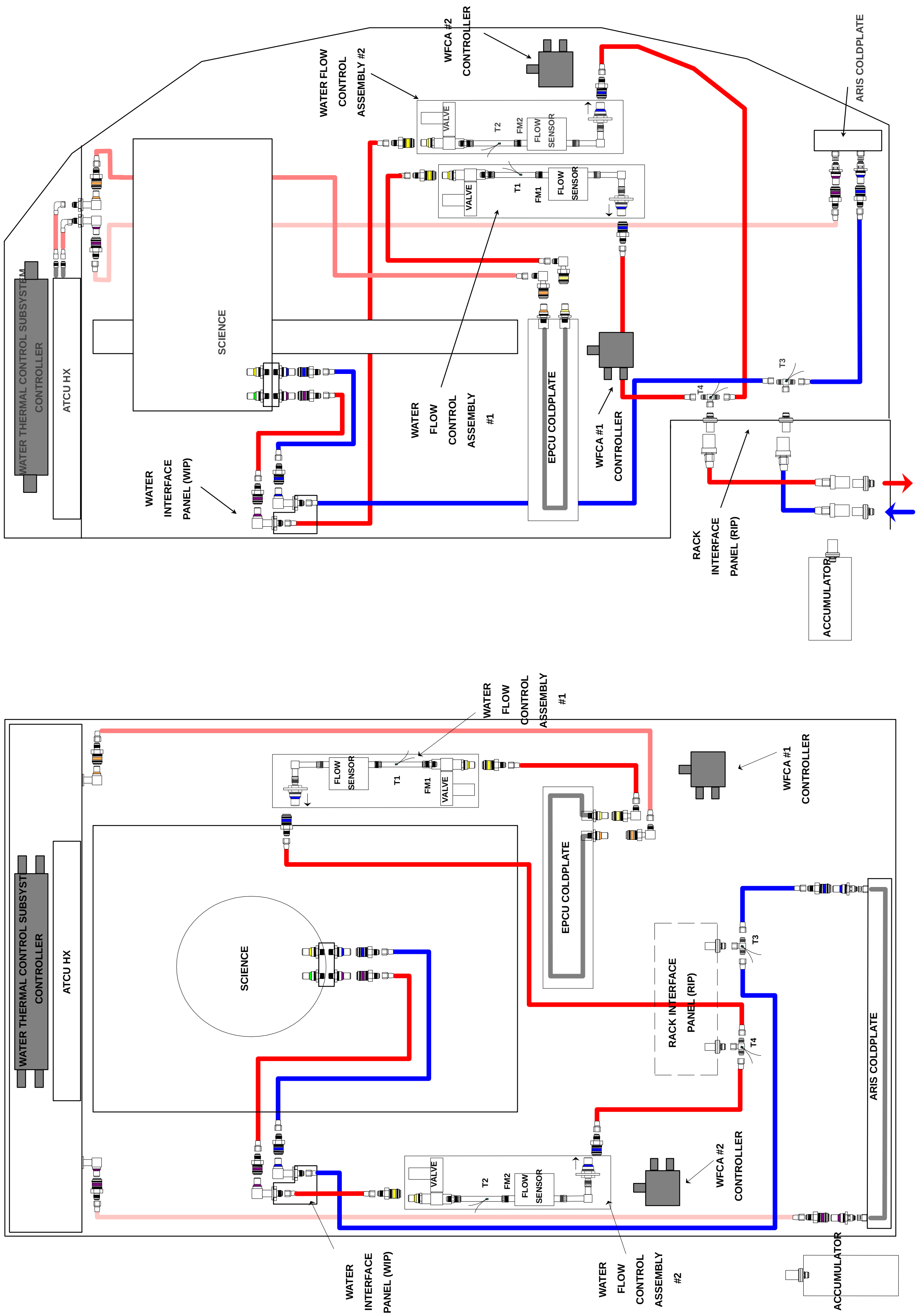


FIGURE 3.5.1.2–1 FIR FLUID LOOP SCHEMATIC

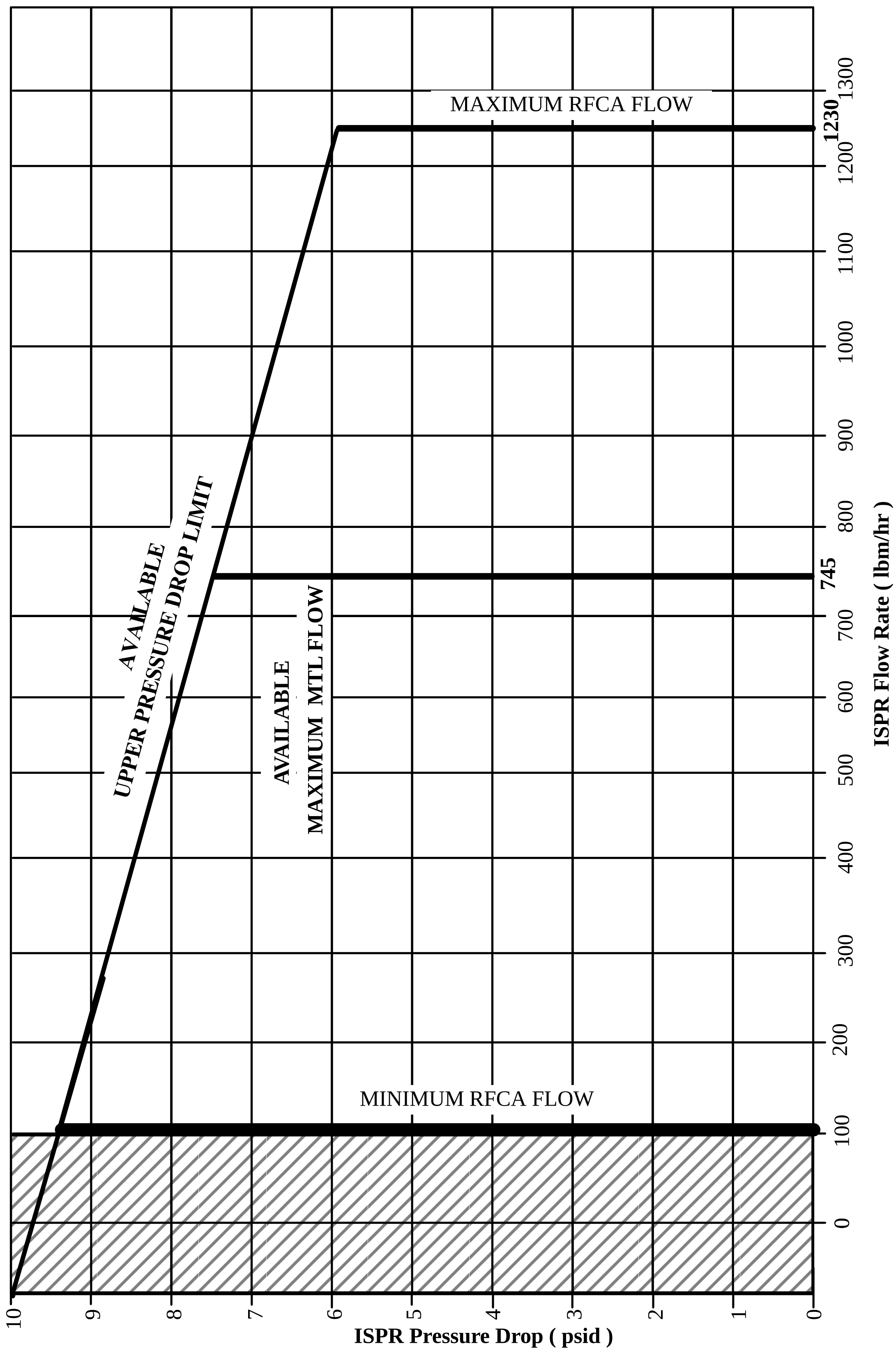


FIGURE 3.5.1.2–2 U.S. LAB AVAILABLE PRESSURE DROP VS. FLOW RATE

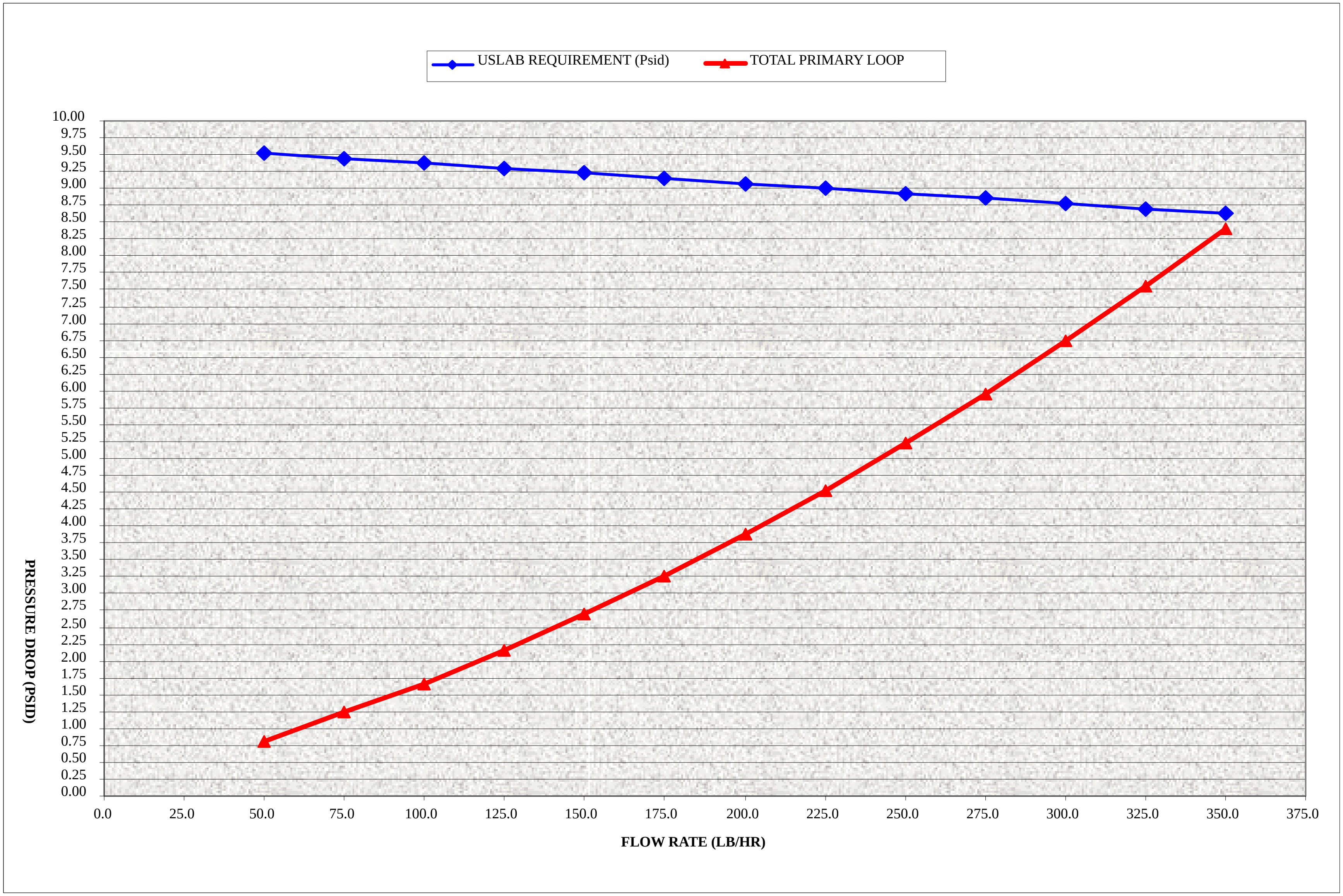


FIGURE 3.5.1.2–3 FIR PRESSURE DROP VS. FLOW RATE

3.5.1.3 COOLANT SUPPLY TEMPERATURE

The ITCS coolant loop supply temperatures in the USL MTL are 61 ° – 65 °F (16 ° – 18.3 °C).

The FIR does not utilize the MPLM coolant interfaces.

3.5.1.4 DELETED

3.5.1.5 SIMULTANEOUS COOLING

The FIR does not utilize the LTL coolant interface; thus simultaneous cooling will not be utilized.

3.5.1.6 INTEGRATED RACK COOLANT QUANTITY

The maximum total water volume available for payload use from the MTL in the USL is 42.25 gallons (159.9 liters). The quantity of coolant contained in the FIR is 1.8 gallons (6.6 liters).

3.5.1.7 INTEGRATED RACK ALLOWABLE AIR INCLUSION

The integrated rack internal cooling loop air inclusion limits are defined in Table 3.5.1.7–1. The quantity of air contained in the FIR coolant is provided in Table 3.5.1.7–1.

TABLE 3.5.1.7–1 INTEGRATED RACK AIR INCLUSION

Loop/Lab	USL Limit in.^{3} (liters)	FIR in.^{3} (liters)	FSS Use
MTL	8.88 (0.146)	**(TBD #15)**	X

3.5.1.8 CABIN AIR HEAT LEAK

The FIR will not exceed the allowable cabin air sensible heat load capability limits of Table 3.5.1.8–1. The numbers in this Table are the total cabin sensible heat load allocation for all the ISPRs on a module basis. The FIR will not exceed the allowable cabin air latent heat load capability limits of Table 3.5.1.8–2. The numbers in this table are the total cabin latent heat load allocation for all the ISPRs on a module basis.

TABLE 3.5.1.8–1 CABIN AIR SENSIBLE HEAT LOAD

USL Limit	FIR LOAD
500 W	**(TBD #16)**

TABLE 3.5.1.8–2 CABIN AIR LATENT HEAT LOAD

USL Limit	FIR LOAD
70 W	**(TBD #17)**

3.5.1.9 CABIN AIR COOLING

Cabin air cooling is the amount of heat transferred from the cabin air into an integrated rack. FIR heat load absorption shall be no greater than the maximum values listed in Table 3.5.1.9–1, with linear interpolation to ambient temperatures between the specified values.

TABLE 3.5.1.9–1 AIR HEAT LOAD

Ambient Temperature	Max Heat Load	FIR Load
15.5 °C (60 °F)	68 W	**(TBD #18)**
49 °C (120 °F)	140 W	

3.6 VACUUM SYSTEM REQUIREMENTS

3.6.1 VACUUM EXHAUST SYSTEM (VES) / WASTE GAS SYSTEM (WGS)

The Vacuum Exhaust System / Waste Gas System (VES / WGS) is capable of reaching a pressure at the ISPR interface of 1 x 10^{-3} torr (0.13 Pa) in less than two hours for a single payload/facility volume of 100 liters at an initial pressure of 14.7 psia (101 kPa); dry air at 70 °F (21 °C) assuming zero leakage and out/offgassing and infinite conductivity between payload/facility volume and the rack interface. The ISPR locations in the USL providing VES / WGS capabilities are illustrated in Figure 3.6.1–1. The location of the VES / WGS interface at the UIP is defined in Figures 3.1.2–1 and 3.1.2–2. The VES / WGS connector is defined in Table 3.1.2–1.

3.6.1.1 ACCEPTABLE EXHAUST GASES

A list of acceptable exhaust gases with verified compatibility to the VES is documented in Table D–1 of SSP 57000. The FIR vented gases are identified in Table 3.6.1.1–1. Contingency events definition are **(TBD #19)**.

TABLE 3.6.1.1–1 FIR VENTED GASES

Constituent	**Mass (kg)**	**Temp °C**	**Total Pressure (kPa)**	**Concentration***
(TBD #20)				

* Concentrations are in mg/m^3 unless otherwise indicated.

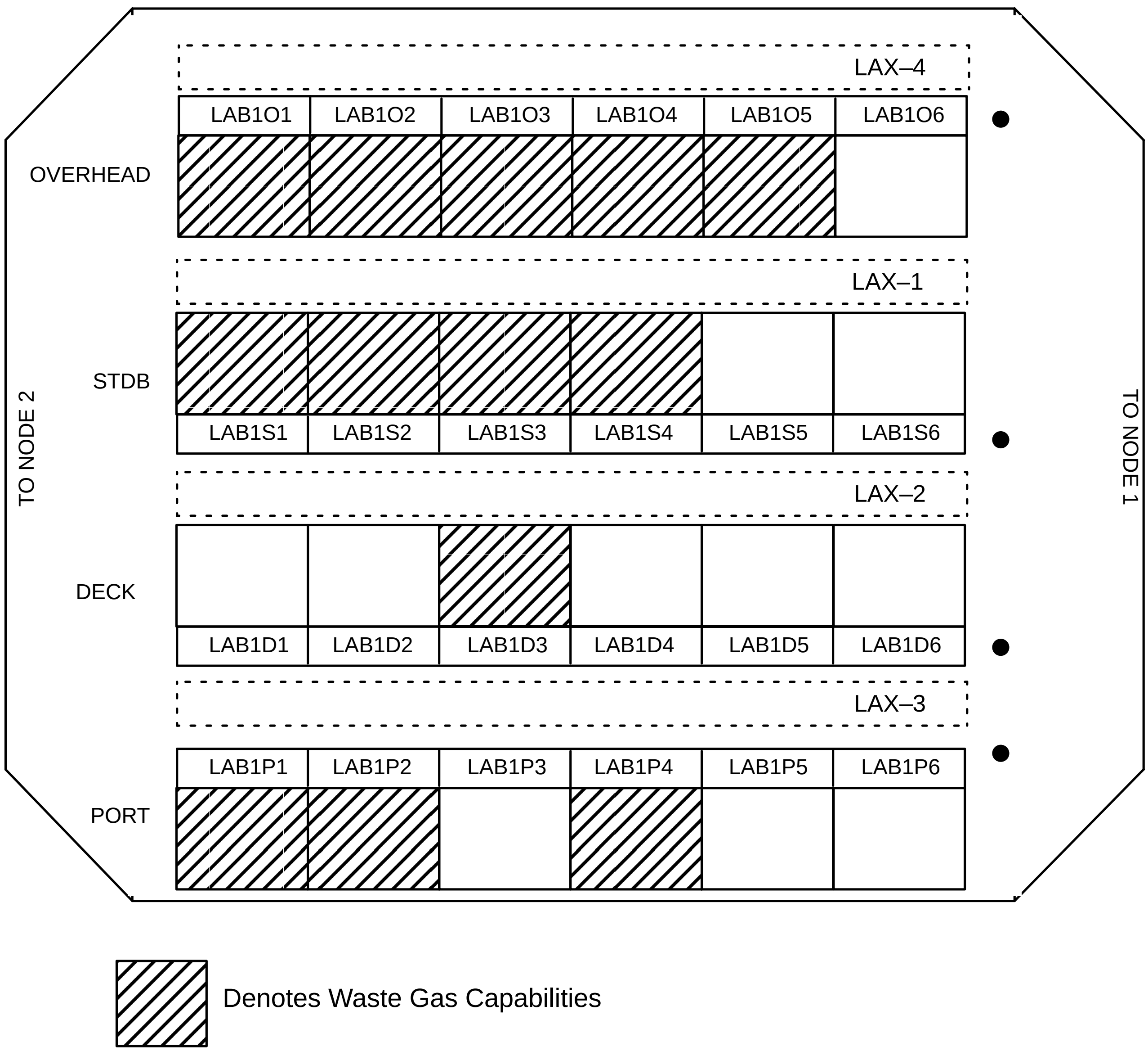


FIGURE 3.6.1–1 USL VES / WGS INTERFACE LOCATIONS

3.6.1.2 INCOMPATIBLE GASES

The FIR will provide containment, storage, and transport hardware for gases that are incompatible with the VES or external environment. The gases utilized by the FIR that are not compatible with the VES or external environment are identified in Table 3.6.1.2–1.

TABLE 3.6.1.2–1 INCOMPATIBLE GASES

Constituent	Mass (kg)	Temp °C	Containment Method
(TBD #21)			

3.6.2 VACUUM RESOURCE SYSTEM (VRS) / VACUUM VENT SYSTEM (VVS)

The Vacuum Resource System / Vacuum Vent System (VRS / VVS) in the USL has the capability to maintain a single payload facility volume at 0.13 Pa when the total gas load, including leakage and out / offgassing does not exceed 1.0 x 10^{-3} mbar–liter/sec assuming infinite conductance between payload facility volume and the ISPR interface. The location of the VRS / VVS interfaces at the UIP are defined in Figures 3.1.2–1 and 3.1.2–2. The VRS / VVS connector is defined in Table 3.1.2–1. The ISPR locations which provide VRS / VVS capabilities are identified in Figure 3.6.2–1.

3.6.2.1 ACCEPTABLE GASES

A list of acceptable gases with verified compatibility to the VRS will be documented in Table D–1 of SSP 57000. The FIR vented gases are identified in Table 3.6.1.1–1. Contingency events are covered by using absorbents to remove any gases that are unacceptable.

3.7 PRESSURIZED GASES INTERFACE REQUIREMENTS

The ISS provides gaseous nitrogen (GN_2) to the FIR.

The location of the pressurized gas interfaces at the UIP are defined in Figures 3.1.2–1 and 3.1.2–2. The pressurized gas connectors are defined in Table 3.1.2–1.

The physical and chemical properties of the provided gases are per SSP 30573, Space Station Program Fluid Procurement and Use Control Specification.

A schematic of the FIR pressurized system is provided in Figure 3.7–1.

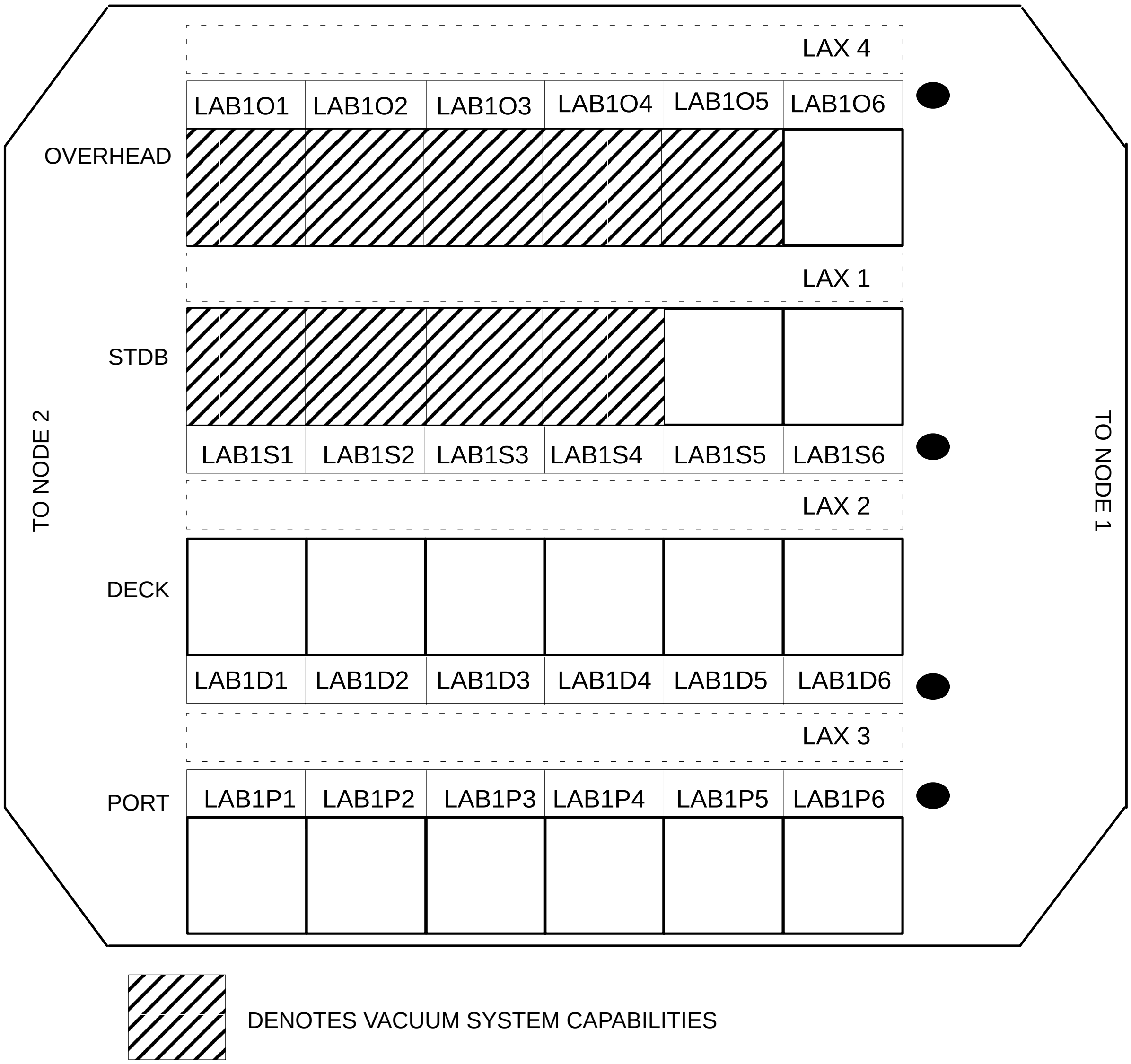


FIGURE 3.6.2–1 USL VRS / VVS INTERFACE LOCATIONS

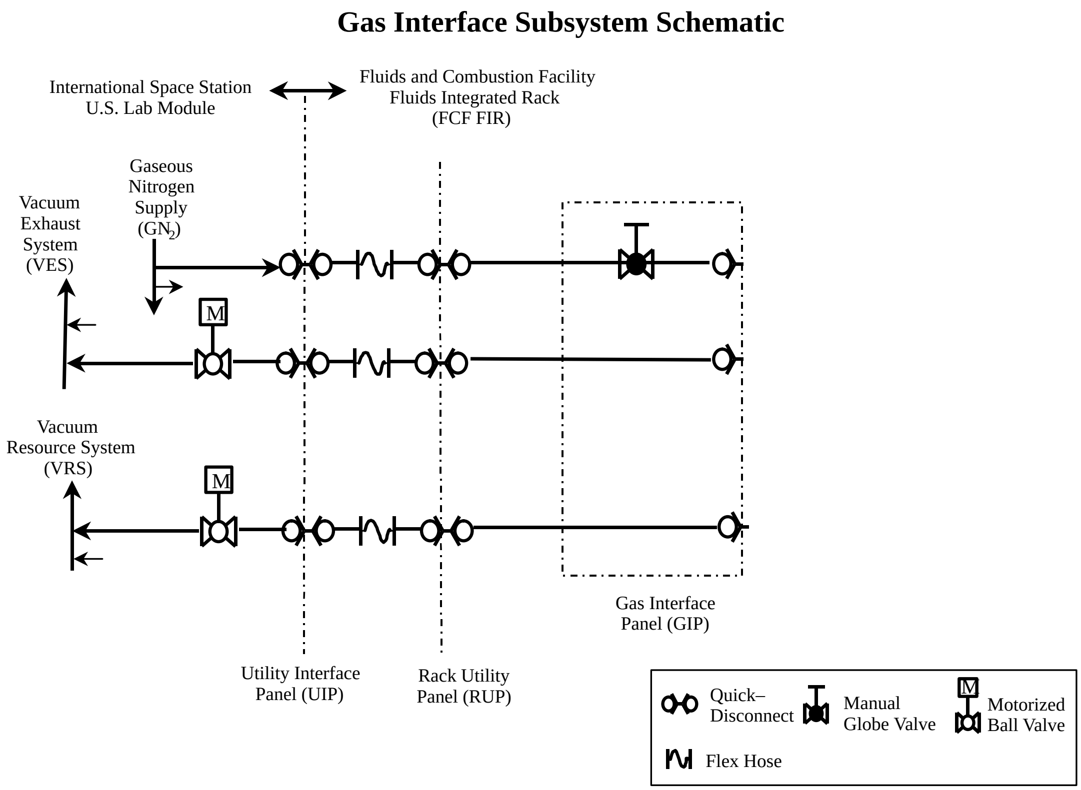


FIGURE 3.7–1 FIR PRESSURIZED GAS SCHEMATIC

3.8 PAYLOAD SUPPORT SERVICES INTERFACES REQUIREMENTS

3.8.1 POTABLE WATER INTERFACE

The FIR does not utilize the potable water interface.

3.8.2 FLUID SYSTEM SERVICER

The Fluid System Servicer (FSS) can supply ITCS coolant water to, or remove it from, the FIR on orbit. The FSS interface connectors are defined in Table 3.1.2–1. The physical and chemical properties of the ITCS coolant water are per SSP 30573.

The FIR will utilize the FSS for each process identified in Table 3.8.2–1. The quantity of coolant required by the FIR from the FSS and the quantity of coolant returned to the FSS is defined in Table 3.8.2–1.

TABLE 3.8.2–1 FSS USAGE

Process	Quantity Required (gal)	Quantity Returned (gal)
(TBD #22)		

3.9 ENVIRONMENTAL INTERFACES

3.9.1 MICROGRAVITY

3.9.1.1 QUASI–STEADY REQUIREMENTS

The FIR quasi–steady disturbance sources are defined in Table 3.9.1.1–1.

TABLE 3.9.1.1–1 QUASI–STEADY DISTURBANCE

FORCE (LBS)	UNIT VECTOR COMPONENTS			DURATION (SEC)
	X	Y	Z	
(TBD #23)				

3.9.1.2 VIBRATORY REQUIREMENTS

The FIR vibratory disturbances are defined in Figure 3.9.1.2–1.

(TBD #24)

FIGURE 3.9.1.2–1 FIR VIBRATORY DISTURBANCE

3.9.1.3 TRANSIENT REQUIREMENTS

The FIR transient disturbances are defined in Table 3.9.1.3–1.

TABLE 3.9.1.3–1 FIR TRANSIENT DISTURBANCES

Source	Force (lbs)	Frequency [1] (Hz)	Duration (sec)	Separation [2] (sec)
(TBD #25)				

Notes:
[1] Frequency of "0" Indicates Pulse
[2] Time Between Transients (Mean)

3.9.2 ACOUSTICS

3.9.2.1 CONTINUOUS NOISE

An integrated rack which operates for more than 8 hours in a 24 hour period and generates a Sound Pressure Level (SPL) greater than or equal to 37 dBA is classified as a Continuous Noise Source. An integrated rack which is classified as a Continuous Noise Source must either meet the limits defined in Table 3.9.2.1–1 or demonstrate that the cumulative time it generates noise above the limits defined in Table 3.9.2.1–1 during a 24 hour period meets the Intermittent Noise Limits defined in Table 3.9.2.2–1.

The FIR Continuous Noise characteristics are defined in Table 3.9.2.1–1.

TABLE 3.9.2.1–1 CONTINUOUS NOISE

Overall A–Weighted SPL (dBA)		
Frequency Band (Hz)	**Integrated Rack SPL (dB) Limit**	**FIR Continuous SPL (dB)**
63	64	**(TBD #26)**
125	56	
250	50	
500	45	
1000	41	
2000	39	
4000	38	
8000	37	

Note: The integrated rack SPL is to be measured at a distance of 0.6 meters from the test article.

3.9.2.2 INTERMITTENT NOISE

An integrated rack which operates for less than 8 hours in a 24 hour period and generates a SPL greater than or equal to 37 dBA measured at a distance of 0.6 meters from the noisiest part of the rack is classified as an Intermittent Noise Source. An integrated rack classified as an Intermittent Noise Source must meet the total rack A–weighted SPL limits defined in Table 3.9.2.2–1.

The FIR Intermittent Noise characteristics are defined in Table 3.9.2.2–1.

TABLE 3.9.2.2–1 INTERMITTENT NOISE LIMITS

Maximum Rack Noise Duration Per 24 Hour Period	Total Rack A–Weighted SPL (dBA) Limit	FIR Intermittent SPL (dBA)
8 Hours	49	**(TBD #27)**
7 Hours	50	
6 Hours	51	
5 Hours	52	
4 Hours	54	
3 Hours	57	
2 Hours	60	
1 Hour	65	
30 Minutes	69	
15 Minutes	72	
5 Minutes	76	
2 Minutes	78	
1 Minute	79	
Not Allowed	80	

3.9.3 HUMIDITY INTERFACE

Equipment within the FIR does not condense humidity from the cabin atmosphere.

3.9.4 ACTIVE AIR EXCHANGE

Cabin air may be used for ventilation but may not be used for cooling of payload equipment mounted in the FIR.

The FIR does not utilize processes that involve active air exchange with cabin atmosphere.

(This Page Intentionally Left Blank)

4.0 APPLICABILITY MATRIX

4.1 PURPOSE

The purpose of this payload unique ICD is to define and control the design of interfaces between the ISS and the FCF / FIR. The integrated rack or payload interfaces are defined by direct reference to the corresponding sections and subsections of the Pressurized Payload Interface Requirements Document (IRD), SSP 57000. The payload developer and the ISS Payloads Office must mutually disposition each IRD paragraph and record that disposition in this applicability matrix. The documented applicability matrix for FIR serves as the basis for developing the FIR Unique Payload Verification Plan according to SSP 57010, the Generic Payload Verification Plan.

4.2 ORGANIZATION

In the Applicability Matrix, Table 4.2–1, the numbers and headings are referenced to the corresponding section and subsection of the IRD. Shaded entries are included for reference only, and are not required to be dispositioned. If an entire section is not applicable to the FIR, only the section heading is dispositioned, not the sub–paragraphs.

Each paragraph of the IRD shall be dispositioned with one of the following:

A Applicable to this ICD, indicating that the referenced interface is utilized by the integrated rack facility or payload hardware item.

N/A Not Applicable to this ICD, indicating that the referenced interface is not utilized by the integrated rack facility or payload hardware item. A brief explanation is given for each requirement listed as not applicable.

E-## Exception with the exception identifier (reference) number ## as listed in the “Exceptions” table found in Section 5.0. An exception indicates that the current hardware design does not fully meet the indicated IRD requirement and that the payload is requesting an exception to the base requirement.

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 1 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.0	PAYLOAD INTERFACE REQUIREMENTS AND GUIDANCE	
3.1	STRUCTURAL/MECHANICAL AND MICROGRAVITY AND STOWAGE INTERFACE REQUIREMENTS	
3.1.1	STRUCTURAL/MECHANICAL	
3.1.1.1.A	GSE INTERFACES	A
3.1.1.1.B	GSE INTERFACES	A
3.1.1.1.C	GSE INTERFACES	A
3.1.1.1.D	GSE INTERFACES	A
3.1.1.2.A	MPLM INTERFACES	A
3.1.1.2.B	MPLM INTERFACES	A
3.1.1.2.C	DELETED	
3.1.1.2.D	DELETED	
3.1.1.2.E	MPLM INTERFACES	A
3.1.1.2.1	MPLM LATE/EARLY ACCESS REQUIREMENTS	A
3.1.1.2.1.1.A	MPLM LATE ACCESS ENVELOPE (KSC)	A
3.1.1.2.1.1.B	MPLM LATE ACCESS ENVELOPE (KSC)	A
3.1.1.2.1.1.C	MPLM LATE ACCESS ENVELOPE (KSC)	A
3.1.1.2.1.2.A	MPLM EARLY ACCESS ENVELOPES (KSC AND DFRC)	A
3.1.1.2.1.2.B	MPLM EARLY ACCESS ENVELOPES (KSC AND DFRC)	A
3.1.1.3.A	LOADS REQUIREMENTS	A
3.1.1.3.B	LOADS REQUIREMENTS	A
3.1.1.3.C	LOADS REQUIREMENTS	A
3.1.1.3.D	LOADS REQUIREMENTS	A
3.1.1.3.E	LOADS REQUIREMENTS	A
3.1.1.3.F	LOADS REQUIREMENTS	A
3.1.1.4.A	RACK REQUIREMENTS	A
3.1.1.4.B	RACK REQUIREMENTS	A
3.1.1.4.C	RACK REQUIREMENTS	A
3.1.1.4.D	RACK REQUIREMENTS	
3.1.1.4.E	RACK REQUIREMENTS	A
3.1.1.4.F	RACK REQUIREMENTS	N/A The FIR does not utilize the lab window rack location
3.1.1.4.G	DELETED	
3.1.1.4.H	DELETED	
3.1.1.4.I	RACK REQUIREMENTS	A
3.1.1.4.J	DELETED	

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 2 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.1.1.4.K	RACK REQUIREMENTS	A
3.1.1.4.L	RACK REQUIREMENTS	A
3.1.1.4.M	RACK REQUIREMENTS	A
3.1.1.4.1	LAB WINDOW RACK LOCATION REQUIREMENTS	N/A The FIR does not utilize the lab window rack location
3.1.1.5.A	SAFETY CRITICAL STRUCTURES REQUIREMENTS	A
3.1.1.6	CONNECTOR AND UMBILICAL PHYSICAL MATE	
3.1.1.6.1	CONNECTOR PHYSICAL MATE	A
3.1.1.6.2	UMBILICAL PHYSICAL MATE	A
3.1.1.7.A	ON–ORBIT PAYLOAD PROTRUSIONS	A
3.1.1.7.B	ON–ORBIT PAYLOAD PROTRUSIONS	A
3.1.1.7.1	ON–ORBIT PERMANENT PROTRUSIONS	A
3.1.1.7.2.A	ON–ORBIT SEMI–PERMANENT PROTRUSIONS	A
3.1.1.7.2.B	ON–ORBIT SEMI–PERMANENT PROTRUSIONS	A
3.1.1.7.2.C	ON–ORBIT SEMI–PERMANENT PROTRUSIONS	A
3.1.1.7.3.A	ON–ORBIT TEMPORARY PROTRUSIONS	E–01
3.1.1.7.3.B	ON–ORBIT TEMPORARY PROTRUSIONS	A
3.1.1.7.4	ON–ORBIT MOMENTARY PROTRUSIONS	A
3.1.1.7.5	ON–ORBIT PROTRUSIONS FOR KEEP–ALIVE PAYLOADS	N/A The FIR is not a keep–alive payload
3.1.2	MICROGRAVITY	
3.1.2.1.A	QUASI-STEADY REQUIREMENTS	A
3.1.2.1.B	QUASI-STEADY REQUIREMENTS	A
3.1.2.2.A	VIBRATORY REQUIREMENTS	A
3.1.2.2.B	VIBRATORY REQUIREMENTS	A
3.1.2.3.A	TRANSIENT REQUIREMENTS	A
3.1.2.3.B	TRANSIENT REQUIREMENTS	A
3.1.2.4	MICROGRAVITY ENVIRONMENT	
3.1.2.5	ARIS INTERFACES	
3.1.3	STOWAGE	
3.2	ELECTRICAL INTERFACE REQUIREMENTS	
3.2.1	ELECTRICAL POWER CHARACTERISTICS	
3.2.1.1	STEADY–STATE VOLTAGE CHARACTERISTICS	
3.2.1.1.1	INTERFACE B	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 3 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.1.1.2	INTERFACE C	N/A The FIR does not utilize Interface C
3.2.1.2	RIPPLE VOLTAGE CHARACTERISTICS	
3.2.1.2.1	RIPPLE VOLTAGE AND NOISE	A
3.2.1.2.2	RIPPLE VOLTAGE SPECTRUM	A
3.2.1.3	TRANSIENT VOLTAGES	
3.2.1.3.1	INTERFACE B	A
3.2.1.3.2	INTERFACE C	N/A The FIR does not utilize Interface C
3.2.1.3.3	FAULT CLEARING AND PROTECTION	A
3.2.1.3.4.A	NON–NORMAL VOLTAGE RANGE	A
3.2.1.3.4.B	NON–NORMAL VOLTAGE RANGE	A
3.2.2	ELECTRICAL POWER INTERFACE	
3.2.2.1.A	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.B	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	A
3.2.2.1.C	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	A
3.2.2.1.D	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.E	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	N/A The FIR does not utilize the UOP
3.2.2.1.F	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	N/A The FIR does not utilize the UOP
3.2.2.2.A	POWER BUS ISOLATION	A
3.2.2.2.B	POWER BUS ISOLATION	A
3.2.2.3	COMPATIBILITY WITH SOFT START / STOP RPC	A
3.2.2.4	SURGE CURRENT	A
3.2.2.5	REVERSE ENERGY / CURRENT	A
3.2.2.6	CIRCUIT PROTECTION DEVICES	
3.2.2.6.1	ISS EPS CIRCUIT PROTECTION CHARACTERISTICS	
3.2.2.6.1.1.A	REMOTE POWER CONTROLLERS (RPCs)	A
3.2.2.6.1.1.B	REMOTE POWER CONTROLLERS (RPCs)	N/A The FIR is not powered while in the MPLM
3.2.2.6.1.1.C	REMOTE POWER CONTROLLERS (RPCs)	N/A The FIR does not utilize the UOP
3.2.2.6.1.1.D	REMOTE POWER CONTROLLERS (RPCs)	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 4 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.2.6.1.1.E	REMOTE POWER CONTROLLERS (RPCs)	A
3.2.2.6.2	EPCE RPC INTERFACE REQUIREMENTS	
3.2.2.6.2.1	RPC TRIP COORDINATION	
3.2.2.6.2.1.1	PAYLOAD TRIP RATINGS	A
3.2.2.7	EPCE COMPLEX LOAD IMPEDANCES	
3.2.2.7.1.A	INTERFACE B	A
3.2.2.7.1.B	INTERFACE B	A
3.2.2.7.2	INTERFACE C	N/A The FIR does not utilize Interface C
3.2.2.8	LARGE SIGNAL STABILITY	A
3.2.2.9	MAXIMUM RIPPLE VOLTAGE EMISSIONS	A
3.2.2.10.A	ELECTRICAL LOAD–STAND ALONE STABILITY	A
3.2.2.10.B	ELECTRICAL LOAD–STAND ALONE STABILITY	A
3.2.2.10.C	ELECTRICAL LOAD–STAND ALONE STABILITY	A
3.2.2.11	ELECTRICAL LOAD INDUCTANCE	
3.2.3	ELECTRICAL POWER CONSUMER CONSTRAINTS	
3.2.3.1.A	WIRE DERATING	N/A The FIR does not utilize the UOP
3.2.3.1.B	WIRE DERATING	A
3.2.3.1.C	WIRE DERATING	A
3.2.3.2.A	EXCLUSIVE POWER FEEDS	A
3.2.3.2.B	EXCLUSIVE POWER FEEDS	A
3.2.3.3	LOSS OF POWER	A
3.2.4	ELECTROMAGNETIC COMPATIBILITY	A
3.2.4.1	ELECTRICAL GROUNDING	A
3.2.4.2	ELECTRICAL BONDING	A
3.2.4.3	CABLE/WIRE DESIGN AND CONTROL REQUIREMENTS	A
3.2.4.4	ELECTROMAGNETIC INTERFERENCE	A
3.2.4.5	ELECTROSTATIC DISCHARGE	A
3.2.4.6	ALTERNATING CURRENT (ac) MAGNETIC FIELDS	N/A The FIR generates no AC magnetic fields
3.2.4.7	DIRECT CURRENT (dc) MAGNETIC FIELDS	A
3.2.4.8	CORONA	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 5 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.4.9	LIGHTNING	N/A The FIR is not connected to the MPLM electrical system
3.2.4.10	EMI SUSCEPTIBILITY FOR SAFETY–CRITICAL CIRCUITS	A
3.2.5	SAFETY REQUIREMENTS	
3.2.5.1	PAYLOAD ELECTRICAL SAFETY	
3.2.5.1.1	MATING/DEMATING OF POWERED CONNECTORS	A
3.2.5.1.2	SAFETY–CRITICAL CIRCUITS REDUNDANCY	A
3.2.5.2	RACK MAINTENANCE SWITCH (RACK POWER SWITCH)	A
3.2.5.3.A	POWER SWITCHES / CONTROLS	A
3.2.5.3.B	POWER SWITCHES / CONTROLS	A
3.2.5.3.C	POWER SWITCHES / CONTROLS	A
3.2.5.4	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI) / PORTABLE EQUIPMENT DC SOURCING VOLTAGE	N/A The FIR does not provide any portable equipment
3.2.5.5	PORTABLE EQUIPMENT / POWER CORDS	N/A The FIR does not provide any portable equipment
3.2.6	MPLM	N/A The FIR does not receive power from the MPLM
3.3	COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS	
3.3.1	GENERAL REQUIREMENTS	
3.3.2	WORD/BYTE NOTATIONS, TYPES AND DATA TRANSMISSIONS	
3.3.2.1	WORD/BYTE NOTATIONS	A
3.3.2.2	DATA TYPES	A
3.3.2.3.A	DATA TRANSMISSIONS	A
3.3.2.3.B	DATA TRANSMISSIONS	A
3.3.2.3.C	DATA TRANSMISSIONS	A
3.3.3	DELETED	
3.3.4	CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS	
3.3.4.1.A	CCSDS DATA	A
3.3.4.1.B	CCSDS DATA	A
3.3.4.1.C	CCSDS DATA	A
3.3.4.1.1	CCSDS DATA PACKETS	A
3.3.4.1.1.1	CCSDS PRIMARY HEADER	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 6 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.3.4.1.1.2.A	CCSDS SECONDARY HEADER	A
3.3.4.1.1.2.B	CCSDS SECONDARY HEADER	A
3.3.4.1.2	CCSDS DATA FIELD	A
3.3.4.1.3	CCSDS DATA BITSTREAM	A
3.3.4.1.4	CCSDS APPLICATION PROCESS IDENTIFICATION FIELD	
3.3.4.2	CCSDS TIME CODES	
3.3.4.2.1	CCSDS UNSEGMENTED TIME	A
3.3.4.2.2	CCSDS SEGMENTED TIME	
3.3.5	MIL–STD–1553B LOW RATE DATA LINK (LRDL)	A
3.3.5.1	MIL–STD–1553B PROTOCOL	
3.3.5.1.1	STANDARD MESSAGES	A
3.3.5.1.2	COMMANDING	A
3.3.5.1.3	HEALTH AND STATUS DATA	A
3.3.5.1.4.A	SAFETY DATA	A
3.3.5.1.4.B	SAFETY DATA	A
3.3.5.1.4.1	CAUTION AND WARNING	
3.3.5.1.4.1.1	CLASS 1 – EMERGENCY	
3.3.5.1.4.1.2	CLASS 2 – WARNING	A
3.3.5.1.4.1.3	CLASS 3 – CAUTION	A
3.3.5.1.4.1.4	CLASS 4 – ADVISORY	A
3.3.5.1.5	SERVICE REQUESTS	A
3.3.5.1.6	ANCILLARY DATA	
3.3.5.1.7	FILE TRANSFER	A
3.3.5.1.8	LOW RATE TELEMETRY	A
3.3.5.1.9	DEFINED MODE CODES	
3.3.5.1.10	IMPLEMENTED MODE CODES	A
3.3.5.1.11	UNIMPLEMENTED / UNDEFINED MODE CODES	A
3.3.5.1.12	ILLEGAL COMMANDS	A
3.3.5.2	MIL–STD–1553B LOW RATE DATA LINK (LRDL) INTERFACE CHARACTERISTICS	
3.3.5.2.1	LRDL REMOTE TERMINAL ASSIGNMENT	
3.3.5.2.1.1	LRDL CONNECTOR/PIN ASSIGNMENTS	
3.3.5.2.1.2.A	MIL-STD-1553B BUS A AND B CONNECTOR / PIN ASSIGNMENT	
3.3.5.2.1.2.B	MIL-STD-1553B BUS A AND B CONNECTOR / PIN ASSIGNMENT	A
3.3.5.2.1.2.C	MIL-STD-1553B BUS A AND B CONNECTOR / PIN ASSIGNMENT	A
3.3.5.2.1.3	DELETED	
3.3.5.2.1.4.A	REMOTE TERMINAL HARDWIRED ADDRESS CODING	A
3.3.5.2.1.4.B	REMOTE TERMINAL HARDWIRED ADDRESS CODING	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 7 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.3.5.2.1.4.C	REMOTE TERMINAL HARDWIRED ADDRESS CODING	A
3.3.5.2.1.4.D	REMOTE TERMINAL HARDWIRED ADDRESS CODING	A
3.3.5.2.1.4.E	REMOTE TERMINAL HARDWIRED ADDRESS CODING	A
3.3.5.2.2	LRDL SIGNAL CHARACTERISTICS	A
3.3.5.2.3	LRDL CABLING	A
3.3.5.2.4	MULTI–BUS ISOLATION	A
3.3.6	MEDIUM RATE DATA LINK (MRDL)	
3.3.6.1	MRDL PROTOCOL	A
3.3.6.1.1	INTEGRATED RACK PROTOCOLS ON THE MRDL	A
3.3.6.1.2.A	MRDL ADDRESS	A
3.3.6.1.2.B	MRDL ADDRESS	A
3.3.6.1.2.C	MRDL ADDRESS	A
3.3.6.1.3.A	ISPR MRDL CONNECTIVITY	A
3.3.6.1.3.B	ISPR MRDL CONNECTIVITY	A
3.3.6.1.3.C	ISPR MRDL CONNECTIVITY	A
3.3.6.1.4.A	MRDL CONNECTOR / PIN ASSIGNMENTS AND WIRE REQUIREMENTS	
3.3.6.1.4.B	MRDL CONNECTOR / PIN ASSIGNMENTS AND WIRE REQUIREMENTS	A
3.3.6.1.4.C	MRDL CONNECTOR / PIN ASSIGNMENTS AND WIRE REQUIREMENTS	A
3.3.6.1.4.D	MRDL CONNECTOR / PIN ASSIGNMENTS AND WIRE REQUIREMENTS	A
3.3.6.1.5	MRDL SIGNAL CHARACTERISTICS	A
3.3.6.1.6	MRDL CABLE CHARACTERISTICS	
3.3.6.1.6.1	INSERTION LOSS	
3.3.6.1.6.2	DIFFERENTIAL CHARACTERISTIC IMPEDANCE	A
3.3.6.1.6.3	MEDIUM TIMING JITTER	
3.3.7	HIGH RATE DATA LINK (HRDL)	
3.3.7.1	PAYLOAD TO HIGH RATE FRAME MULTIPLEXER (HRFM) PROTOCOLS	A
3.3.7.2	HRDL INTERFACE CHARACTERISTICS	
3.3.7.2.1	PHYSICAL SIGNALING	
3.3.7.2.1.1.A	PHYSICAL SIGNALING DATA RATES	A
3.3.7.2.1.1.B	PHYSICAL SIGNALING DATA RATES	A
3.3.7.2.1.1.C	PHYSICAL SIGNALING DATA RATES	A
3.3.7.2.2	ENCODING	A
3.3.7.3	INTEGRATED RACK HRDL OPTICAL POWER	
3.3.7.3.1	INTEGRATED RACK HRDL TRANSMITTED OPTICAL POWER	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 8 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.3.7.3.2	INTEGRATED RACK HRDL RECEIVED OPTICAL POWER	N/A The FIR does not have a receiver for optical power
3.3.7.4	HRDL FIBER OPTIC CABLE	A
3.3.7.5	HRDL FIBER OPTIC CABLE BEND RADIUS	A
3.3.7.6.A	HRDL CONNECTORS AND FIBER	
3.3.7.6.B	HRDL CONNECTORS AND FIBER	A
3.3.7.6.C	HRDL CONNECTORS AND FIBER	A
3.3.7.6.D	HRDL CONNECTORS AND FIBER	A
3.3.8	PERSONAL COMPUTERS	
3.3.8.1	PAYLOAD LAPTOP	N/A The FIR does not utilize a unique payload laptop
3.3.8.2	PCS	N/A The FIR does not utilize the PCS
3.3.8.3	SSC	
3.3.8.3.A	SSC	A
3.3.8.3.B	SSC	A
3.3.9	UOP	
3.3.10	MAINTENANCE SWITCH, SMOKE DETECTOR, SMOKE INDICATOR, AND INTEGRATED RACK FAN INTERFACES	
3.3.10.1.A	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) INTERFACES	A
3.3.10.1.B	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) INTERFACES	A
3.3.10.2	SMOKE DETECTOR INTERFACES	
3.3.10.2.1	ANALOG INTERFACE CHARACTERISTICS	A
3.3.10.2.2	DISCRETE COMMAND BUILT-IN-TEST INTERFACE CHARACTERISTICS	A
3.3.10.2.3	SMOKE INDICATOR ELECTRICAL INTERFACES	A
3.3.10.2.4	FAN VENTILATION STATUS ELECTRICAL INTERFACES	A
3.3.10.3.A	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) / FIRE DETECTION SUPPORT INTERFACE CONNECTOR	
3.3.10.3.B	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) / FIRE DETECTION SUPPORT INTERFACE CONNECTOR	A
3.3.10.3.C	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) / FIRE DETECTION SUPPORT INTERFACE CONNECTOR	A
3.4	PAYLOAD NTSC VIDEO AND AUDIO INTERFACE REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 9 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.4.1	PAYLOAD NTSC VIDEO INTERFACE REQUIREMENTS	
3.4.1.1.A	PAYLOAD NTSC OPTICAL VIDEO CHARACTERISTICS	A
3.4.1.1.B	PAYLOAD NTSC OPTICAL VIDEO CHARACTERISTICS	A
3.4.1.1.C	PAYLOAD NTSC OPTICAL VIDEO CHARACTERISTICS	A
3.4.1.2	NTSC FIBER OPTIC VIDEO	
3.4.1.2.1.A	PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS	A
3.4.1.2.1.B	PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS	A
3.4.1.2.2	INTEGRATED RACK NTSC PFM VIDEO TRANSMITTED OPTICAL POWER	A
3.4.1.2.3	INTEGRATED RACK NTSC PFM VIDEO AND SYNC SIGNAL RECEIVED OPTICAL POWER	N/A The FIR does not receive video signals
3.4.1.2.4	FIBER OPTIC CABLE CHARACTERISTICS	A
3.4.1.2.5	PFM NTSC VIDEO FIBER OPTIC CABLE BEND RADIUS	A
3.4.1.2.6	DELETED	
3.4.1.2.7.A	PFM NTSC OPTICAL CONNECTOR / PIN ASSIGNMENTS	
3.4.1.2.7.B	PFM NTSC OPTICAL CONNECTOR / PIN ASSIGNMENTS	A
3.4.1.2.7.C	PFM NTSC OPTICAL CONNECTOR / PIN ASSIGNMENTS	A
3.4.1.3	NTSC ELECTRICAL VIDEO INTERFACES	N/A The FIR does not interface to the JEM
3.4.1.4.A	NTSC ELECTRICAL CONNECTOR / PIN ASSIGNMENTS	
3.4.1.4.B	NTSC ELECTRICAL CONNECTOR / PIN ASSIGNMENTS	A
3.4.1.4.C	NTSC ELECTRICAL CONNECTOR / PIN ASSIGNMENTS	A
3.4.2	U.S. ELEMENT AUDIO INTERFACE REQUIREMENTS	
3.5	THERMAL CONTROL INTERFACE REQUIREMENTS	
3.5.1	INTERNAL THERMAL CONTROL SYSTEM (ITCS) INTERFACE REQUIREMENTS	
3.5.1.1.A	PHYSICAL INTERFACE	
3.5.1.1.B	PHYSICAL INTERFACE	
3.5.1.2.A	ITCS FLUID USE AND CHARGING – ITCS FLUID USE	A
3.5.1.2.B	ITCS FLUID USE AND CHARGING – INTEGRATED RACK CHARGING	A
3.5.1.3.A	ITCS PRESSURE DROP – ON–ORBIT INTERFACES	E–02

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 10 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.5.1.3.B	ITCS PRESSURE DROP – MPLM INTERFACES	N/A The FIR does not require active cooling in the MPLM
3.5.1.4.A	COOLANT FLOW RATE–MTL	A
3.5.1.4.B	COOLANT FLOW RATE–LTL	N/A The FIR does not utilize the LTL
3.5.1.5.A	COOLANT SUPPLY TEMPERATURE–MTL	A
3.5.1.5.B	COOLANT SUPPLY TEMPERATURE–LTL	N/A The FIR does not utilize the LTL
3.5.1.6.A	COOLANT RETURN TEMPERATURE	A
3.5.1.6.B	COOLANT RETURN TEMPERATURE	A
3.5.1.6.C	COOLANT RETURN TEMPERATURE	A
3.5.1.6.D	COOLANT RETURN TEMPERATURE	N/A The FIR does not utilize the LTL
3.5.1.7.A	COOLANT MAXIMUM DESIGN PRESSURE–MTL	A
3.5.1.7.B	COOLANT MAXIMUM DESIGN PRESSURE–LTL	N/A The FIR does not utilize the LTL
3.5.1.7.C	COOLANT MAXIMUM DESIGN PRESSURE–MPLM Temperature Loop	N/A The FIR does not require active cooling in the MPLM
3.5.1.8	FAIL SAFE DESIGN	A
3.5.1.9.A	LEAKAGE	A
3.5.1.9.B	LEAKAGE	N/A The FIR does not operate in the MPLM
3.5.1.10	QUICK–DISCONNECT AIR INCLUSION	A
3.5.1.11	RACK FRONT SURFACE TEMPERATURE	A
3.5.1.12	CABIN AIR HEAT LEAK	
3.5.1.13	MPLM CABIN AIR COOLING	N/A The FIR does not operate in the MPLM

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 11 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.5.1.14	SIMULTANEOUS COOLING	N/A The FIR does not utilize simultaneous cooling
3.5.1.15	CONTROL SYSTEM TIME CONSTANT	A
3.5.1.16	PAYLOAD COOLANT QUANTITY	A
3.5.1.17	PAYLOAD GAS INCLUSION	A
3.6	VACUUM SYSTEM REQUIREMENTS	
3.6.1	VACUUM EXHAUST SYSTEM (VES) / WASTE GAS SYSTEM (WGS) REQUIREMENTS	
3.6.1.1	VES / WGS PHYSICAL INTERFACE	
3.6.1.2.A	INPUT PRESSURE LIMIT	A
3.6.1.2.B	INPUT PRESSURE LIMIT	A
3.6.1.2.C	INPUT PRESSURE LIMIT	A
3.6.1.3	INPUT TEMPERATURE LIMIT	A
3.6.1.4	INPUT DEWPOINT LIMIT	A
3.6.1.5.A	ACCEPTABLE EXHAUST GASES	A
3.6.1.5.B	ACCEPTABLE EXHAUST GASES	A
3.6.1.5.C	ACCEPTABLE EXHAUST GASES	A
3.6.1.5.D	ACCEPTABLE EXHAUST GASES	A
3.6.1.5.1.A	ACCEPTABLE GASES - LIST	
3.6.1.5.1.B	ACCEPTABLE GASES - LIST	
3.6.1.5.1.C	ACCEPTABLE GASES - LIST	
3.6.1.5.2	EXTERNAL CONTAMINATION CONTROL	A
3.6.1.5.3.A	INCOMPATIBLE GASES	A
3.6.1.5.3.B	INCOMPATIBLE GASES	A
3.6.1.6	PAYLOAD VACUUM SYSTEM ACCESS VALVE	A
3.6.2	VACUUM RESOURCE SYSTEM (VRS) / VACUUM VENT SYSTEM (VVS) REQUIREMENTS	A
3.6.2.1	VRS / VVS PHYSICAL INTERFACE	
3.6.2.2.A	INPUT PRESSURE LIMIT	A
3.6.2.2.B	INPUT PRESSURE LIMIT	A
3.6.2.2.C	INPUT PRESSURE LIMIT	A
3.6.2.3	VRS / VVS THROUGH–PUT LIMIT	A
3.6.2.4	ACCEPTABLE GASES	
3.7	PRESSURIZED GASES INTERFACE REQUIREMENTS	
3.7.1	NITROGEN INTERFACE REQUIREMENTS	
3.7.1.1	NITROGEN INTERFACE CONTROL	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 12 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.7.1.2	NITROGEN INTERFACE MDP	A
3.7.1.3	NITROGEN INTERFACE TEMPERATURE	A
3.7.1.4	NITROGEN LEAKAGE	A
3.7.1.5	NITROGEN PHYSICAL INTERFACE	
3.7.2	ARGON INTERFACE REQUIREMENTS	N/A The FIR does not utilize the argon interface
3.7.3	CARBON DIOXIDE INTERFACE REQUIREMENTS	N/A The FIR does not utilize the CO_2 interface
3.7.4	HELIUM INTERFACE REQUIREMENTS	N/A The FIR does not utilize the helium interface
3.7.5	PRESSURIZED GAS SYSTEMS	A
3.7.6	MANUAL VALVES	A
3.8	PAYLOAD SUPPORT SERVICES INTERFACES REQUIREMENTS	
3.8.1	POTABLE WATER	N/A The FIR does not utilize the potable water interface
3.8.2	FLUID SYSTEM SERVICER	A
3.9	ENVIRONMENT INTERFACE REQUIREMENTS	
3.9.1	ATMOSPHERE REQUIREMENTS	
3.9.1.1	PRESSURE	A
3.9.1.2	TEMPERATURE	A
3.9.1.3	HUMIDITY	A
3.9.2	INTEGRATED RACK USE OF CABIN ATMOSPHERE	
3.9.2.1.A	ACTIVE AIR EXCHANGE	N/A The FIR does not exchange air with cabin atmosphere
3.9.2.1.B	ACTIVE AIR EXCHANGE	N/A The FIR is not aisle mounted
3.9.2.2	OXYGEN CONSUMPTION	N/A The FIR does not consume atmospheric oxygen
3.9.2.3	CHEMICAL RELEASES	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 13 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.9.3	RADIATION REQUIREMENTS	
3.9.3.1	INTEGRATED RACK CONTAINED OR GENERATED IONIZING RADIATION	A
3.9.3.2	IONIZING RADIATION DOSE	
3.9.3.3	SINGLE EVENT EFFECT (SEE) IONIZING RADIATION	A
3.9.3.4	LAB WINDOW RACK LOCATION RADIATION REQUIREMENTS	N/A The FIR does not utilize the lab window rack location
3.9.4	ADDITIONAL ENVIRONMENTAL CONDITIONS	
3.10	FIRE PROTECTION INTERFACE REQUIREMENTS	
3.10.1	FIRE PREVENTION	A
3.10.2	PAYLOAD MONITORING AND DETECTION REQUIREMENTS	
3.10.2.1	SMOKE DETECTION	
3.10.2.1.1.A	SMOKE DETECTOR	A
3.10.2.1.1.B	SMOKE DETECTOR	A
3.10.2.1.2	FORCED AIR CIRCULATION INDICATION	A
3.10.2.1.3A	FIRE DETECTION INDICATOR	A
3.10.2.1.3B	FIRE DETECTION INDICATOR	A
3.10.2.2	PARAMETER MONITORING	
3.10.2.2.1	PARAMETER MONITORING USE	A
3.10.2.2.2	PARAMETER MONITORING RESPONSE	
3.10.2.2.2.1.A	PARAMETER MONITORING IN SUBRACK	A
3.10.2.2.2.1.B	PARAMETER MONITORING IN SUBRACK	A
3.10.2.2.2.2.A	PARAMETER MONITORING IN INTEGRATED RACK	N/A The FIR does not use parameter monitoring alone
3.10.2.2.2.2.B	PARAMETER MONITORING IN INTEGRATED RACK	N/A The FIR does not use parameter monitoring alone
3.10.3	FIRE SUPPRESSION	
3.10.3.1.A	PORTABLE FIRE EXTINGUISHER	A
3.10.3.1.B	PORTABLE FIRE EXTINGUISHER	N/A The FIR panel thickness is not greater than 3.175 mm
3.10.3.2	FIRE SUPPRESSION ACCESS PORT ACCESSIBILITY	A
3.10.3.3	FIRE SUPPRESSANT DISTRIBUTION	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 14 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.10.4.A	LABELING	A
3.10.4.B	LABELING	A
3.11	MATERIALS AND PARTS INTERFACE REQUIREMENTS	
3.11.1	MATERIALS AND PARTS USE AND SELECTION	A
3.11.1.1	COMMERCIAL PARTS	A
3.11.2.A	FLUIDS	A
3.11.2.B	FLUIDS	A
3.11.2.C	FLUIDS	A
3.11.3	CLEANLINESS	A
3.11.4	FUNGUS RESISTANT MATERIAL	A
3.12	HUMAN FACTORS INTERFACE REQUIREMENTS	
3.12.1.A	STRENGTH REQUIREMENTS	A
3.12.1.B	STRENGTH REQUIREMENTS	A
3.12.2	BODY ENVELOPE AND REACH ACCESSIBILITY	
3.12.2.1	ADEQUATE CLEARANCE	A
3.12.2.2.A	ACCESSIBILITY	A
3.12.2.2.B	ACCESSIBILITY	A
3.12.2.3	FULL SIZE RANGE ACCOMMODATION	A
3.12.3	HABITABILITY	
3.12.3.1	HOUSEKEEPING	
3.12.3.1.1	CLOSURES OR COVERS	A
3.12.3.1.2.A	BUILT-IN CONTROL	A
3.12.3.1.2.B	BUILT-IN CONTROL	A
3.12.3.1.3	DELETED	
3.12.3.1.4	DELETED	
3.12.3.1.5	ONE-HANDED OPERATION	A
3.12.3.2	TOUCH TEMPERATURE	
3.12.3.2.1	CONTINUOUS/INCIDENTAL CONTACT - HIGH TEMPERATURE	A
3.12.3.2.2	CONTINUOUS/INCIDENTAL CONTACT - LOW TEMPERATURE	A
3.12.3.3	ACOUSTIC REQUIREMENTS	
3.12.3.3.1.A	CONTINUOUS NOISE LIMITS – Subracks not changed out	N/A The FIR has subrack equipment which will be changed out
3.12.3.3.1.B	CONTINUOUS NOISE LIMITS – Subracks changed out	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 15 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.3.3.1.C	CONTINUOUS NOISE LIMITS – Independently operated equipment	N/A The FIR has no independently operated equipment
3.12.3.3.2	INTERMITTENT NOISE LIMITS	A
3.12.3.4.A	LIGHTING DESIGN	A
3.12.3.4.B	LIGHTING DESIGN	A
3.12.3.4.C	LIGHTING DESIGN	N/A The FIR has no light sources
3.12.3.4.D	LIGHTING DESIGN	A
3.12.3.4.E	LIGHTING DESIGN	A
3.12.4	STRUCTURAL / MECHANICAL INTERFACES	
3.12.4.1	DELETED	
3.12.4.2	PAYLOAD HARDWARE MOUNTING	
3.12.4.2.1	EQUIPMENT MOUNTING	A
3.12.4.2.2	DRAWERS AND HINGED PANELS	A
3.12.4.2.3	DELETED	
3.12.4.2.4	DELETED	
3.12.4.2.5	ALIGNMENT	A
3.12.4.2.6	SLIDE-OUT STOPS	A
3.12.4.2.7	PUSH-PULL FORCE	A
3.12.4.2.8	ACCESS	A
3.12.4.2.8.1	COVERS	A
3.12.4.2.8.2	SELF-SUPPORTING COVERS	A
3.12.4.2.8.3	DELETED	
3.12.4.2.8.4	UNIQUE TOOLS	N/A The FIR does not utilize unique tools
3.12.4.3	CONNECTORS	
3.12.4.3.1	ONE-HANDED OPERATION	A
3.12.4.3.2.A.1	ACCESSIBILITY – NOMINAL OPERATIONS	A
3.12.4.3.2.A.2	ACCESSIBILITY – MAINTENANCE OPERATIONS	A
3.12.4.3.2.A	ACCESSIBILITY	A
3.12.4.3.2.B	ACCESSIBILITY	A
3.12.4.3.3.A	EASE OF DISCONNECT	A
3.12.4.3.3.B	EASE OF DISCONNECT	A
3.12.4.3.4	INDICATION OF PRESSURE/FLOW	A
3.12.4.3.5	SELF LOCKING	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 16 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.4.3.6.A	CONNECTOR ARRANGEMENT	A
3.12.4.3.6.B	CONNECTOR ARRANGEMENT	A
3.12.4.3.7	ARC CONTAINMENT	A
3.12.4.3.8	CONNECTOR PROTECTION	A
3.12.4.3.9	CONNECTOR SHAPE	A
3.12.4.3.10	FLUID AND GAS LINE CONNECTORS	A
3.12.4.3.11.A	ALIGNMENT MARKS OR GUIDE PINS	A
3.12.4.3.12.A	CODING	A
3.12.4.3.12.B	CODING	A
3.12.4.3.13	PIN IDENTIFICATION	A
3.12.4.3.14	ORIENTATION	A
3.12.4.3.15.A	HOSE/CABLE RESTRAINTS	A
3.12.4.3.15.B	HOSE/CABLE RESTRAINTS	A
3.12.4.3.15.C	HOSE/CABLE RESTRAINTS	
3.12.4.3.15.D	HOSE/CABLE RESTRAINTS	A
3.12.4.4	FASTENERS	
3.12.4.4.1	NON–THREADED FASTENERS STATUS INDICATION	A
3.12.4.4.2	MOUNTING BOLT / FASTENER SPACING	A
3.12.4.4.3	DELETED	
3.12.4.4.4.A	MULTIPLE FASTENERS	A
3.12.4.4.5	CAPTIVE FASTENERS	A
3.12.4.4.6.A	QUICK RELEASE FASTENERS	A
3.12.4.4.6.B	QUICK RELEASE FASTENERS	A
3.12.4.4.7	THREADED FASTENERS	A
3.12.4.4.8.A	OVER CENTER LATCHES – NONSELF–LATCHING	A
3.12.4.4.8.B	OVER CENTER LATCHES – LATCH LOCK	A
3.12.4.4.8.C	OVER CENTER LATCHES – LATCH HANDLES	A
3.12.4.4.9	WINGHEAD FASTENERS	A
3.12.4.4.10	DELETED	
3.12.4.4.11.A	FASTENER HEAD TYPE	A
3.12.4.4.11.B	FASTENER HEAD TYPE	A
3.12.4.4.11.C	FASTENER HEAD TYPE	A
3.12.4.4.12	ONE-HANDED ACTUATION	A
3.12.4.4.13	DELETED	
3.12.4.4.14	ACCESS HOLES	A
3.12.5	CONTROLS AND DISPLAYS	
3.12.5.1	CONTROLS SPACING DESIGN REQUIREMENTS	A
3.12.5.2	ACCIDENTAL ACTUATION	

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 17 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.5.2.1	PROTECTIVE METHODS	A
3.12.5.2.2	NONINTERFERENCE	A
3.12.5.2.3	DEAD-MAN CONTROLS	
3.12.5.2.4	BARRIER GUARDS	A
3.12.5.2.5	RECESSED SWITCH PROTECTION	A
3.12.5.2.6	DELETED	
3.12.5.2.7	POSITION INDICATION	A
3.12.5.2.8	HIDDEN CONTROLS	A
3.12.5.2.9	HAND CONTROLLERS	A
3.12.5.3.A	VALVE CONTROLS – LOW TORQUE VALVES	A
3.12.5.3.B	VALVE CONTROLS – INTERMEDIATE TORQUE VALVES	A
3.12.5.3.C	VALVE CONTROLS – HIGH TORQUE VALVES	A
3.12.5.3.D	VALVE CONTROLS – HANDLE DIMENSIONS	A
3.12.5.3.E	VALVE CONTROLS – ROTARY VALVE CONTROLS	A
3.12.5.4	TOGGLE SWITCHES	A
3.12.6	RESTRAINTS AND MOBILITY AIDS	A
3.12.6.1	STOWAGE DRAWER CONTENTS RESTRAINTS	N/A The FIR does not have stowage drawers
3.12.6.2	STOWAGE AND EQUIPMENT DRAWERS/TRAYS	N/A The FIR does not have stowage drawers
3.12.6.3	CAPTIVE PARTS	A
3.12.6.4	HANDLE AND GRASP AREA DESIGN REQUIREMENTS	
3.12.6.4.1	HANDLES AND RESTRAINTS	A
3.12.6.4.2	DELETED	
3.12.6.4.3	HANDLE LOCATION/FRONT ACCESS	A
3.12.6.4.4	HANDLE DIMENSIONS	A
3.12.6.4.5.A	NON-FIXED HANDLES DESIGN REQUIREMENTS	A
3.12.6.4.5.B	NON-FIXED HANDLES DESIGN REQUIREMENTS	A
3.12.6.4.5.C	NON-FIXED HANDLES DESIGN REQUIREMENTS	A
3.12.7	IDENTIFICATION LABELING	A
3.12.8	COLOR	A
3.12.9	CREW SAFETY	
3.12.9.1.A	ELECTRICAL HAZARDS	
3.12.9.1.B	ELECTRICAL HAZARDS	A
3.12.9.1.C	ELECTRICAL HAZARDS	A

TABLE 4.2–1 APPLICABILITY MATRIX
(Page 18 of 18)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.9.1.D	ELECTRICAL HAZARDS	A
3.12.9.1.E	ELECTRICAL HAZARDS	A
3.12.9.1.1	MISMATCHED	A
3.12.9.1.2	DELETED	
3.12.9.1.3	DELETED	
3.12.9.1.4	OVERLOAD PROTECTION	
3.12.9.1.4.1	DEVICE ACCESSIBILITY	A
3.12.9.1.4.2	EXTRACTOR -TYPE FUSE HOLDER	A
3.12.9.1.4.3	OVERLOAD PROTECTION LOCATION	A
3.12.9.1.4.4	OVERLOAD PROTECTION IDENTIFICATION	A
3.12.9.1.4.5	AUTOMATIC RESTART PROTECTION	A
3.12.9.2	SHARP EDGES AND CORNERS PROTECTION	A
3.12.9.3	HOLES	A
3.12.9.4	LATCHES	A
3.12.9.5	SCREWS AND BOLTS	A
3.12.9.6	SECURING PINS	A
3.12.9.7	LEVERS, CRANKS, HOOKS, AND CONTROLS	A
3.12.9.8	BURRS	A
3.12.9.9.A	LOCKING WIRES	A
3.12.9.9.B	LOCKING WIRES	A
3.12.9.10	AUDIO DEVICES (DISPLAYS)	N/A The FIR does not utilize audio devices
3.12.9.11	DELETED	
3.12.9.12	EGRESS	A
3.12.10	PAYLOAD IN-FLIGHT MAINTENANCE	A

(This Page Intentionally Left Blank)

5.0 EXCEPTIONS, DEVIATIONS AND WAIVERS

5.1 EXCEPTIONS TABLE

A summary description and rationale is provided in Table 5.1–1 for each exception to an IRD requirement identified in Table 4.2–1.

TABLE 5.1–1 OPEN EXCEPTIONS

IRD/ICD PARAGRAPH NUMBER	CLASSIFICATION	IDENTIFIER	DESCRIPTION	STATUS
3.1.1.7.3.A / 3.1.1.3.D	Exception	E–01	Rack Door Temporary Protrusion	57218–NA–0001 In Work
3.5.1.3.A / 3.5.1.2	PIRN	E–02	ITCS Pressure Drop	57000–NA–0151H Approved

(This Page Intentionally Left Blank)

APPENDIX A
ABBREVIATIONS AND ACRONYMS

ac	Alternating Current
amps	Amperes
APM	Attached Pressurized Module
APS	Automated Payload Switch
ARIS	Active Rack Isolation System
ARPC	Auxiliary Remote Power Controller
BPDU	Bitstream Protocol Data Unit
C	Centigrade
C&DH	Command & Data Handling
CCSDS	Consultative Committee for Space Data Systems
CAM	Centrifuge Accommodations Module
cg	Center of Gravity
CIR	Combustion Integrated Rack
COF	Columbus Orbiting Facility
dB	deciBel
dBm	deciBels Referenced to One Milliwatt
dc	Direct Current
EEE	Electrical, Electronic, and Electromechanical
EMC CS–01, 02	Electromagnetic Compatibility; Conducted Susceptibility –01 (CS–01), Conducted Susceptibility –02 (CS–02)
EMI	Electromagnetic Interference
EPCE	Electrical Power Consuming Equipment
EPS	Electrical Power System
ESA	European Space Agency
EVA	Extra Vehicular Activity
EWACS	Emergency Warning and Caution System
F	Fahrenheit

FCF	Fluids and Combustion Facility
FDC	Federal Data Corporation
FIR	Fluids Integrated Rack
FSS	Fluid System Servicer
FWHM	Full Width Half Maximum
GFCI	Ground Fault Circuit Interrupter
GRC	Glenn Research Center
GSE	Ground Support Equipment
HRDL	High Rate Data Link
HRFM	High Rate Frame Multiplexer
hr	hour
Hz	Hertz
ICD	Interface Control Document
IDD	Interface Design Document
IEC	International Electro Technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IRD	Interface Requirements Document (SSP 57000)
ISO	International Standards Organization
ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
JEM	Japanese Experiment Module
JSC	Johnson Space Center
kg	kilograms
kHz	kiloHertz
kPa	kiloPascal
KSC	Kennedy Space Center
kW	kiloWatt
LAN	Local Area Network

lbm	pounds mass
LRDL	Low Rate Data Link
LSB	Least Significant Bit
LTL	Low Temperature Loop
mA	milliAmperes
MDM	Multiplexer–Demultiplexer
MDP	Maximum Design Pressure
MIL–STD	Military Standard
MPLM	Mini Pressurized Logistics Module
MRDL	Medium Rate Data Link (Ethernet)
MSB	Most Significant Bit
MSFC	Marshall Space Flight Center
MTL	Moderate Temperature Loop
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NSTS	National Space Transportation System
NTSC	National Television Systems Committee
ORU	Orbital Replacement Unit
Pa	Pascal
PCS	Portable Computer System
PFE	Portable Fire Extinguisher
PFM	Pulse Frequency Modulation
PIA	Payload Interface Agreement
PIRN	Preliminary/Proposed Interface Revision Notice
PL	Payload
PN	Part Number
psia	pounds per square inch absolute
psid	pounds per square inch differential
QD	Quick Disconnect

R/FR	Refrigerator/Freezer
Rev	Revision
RHA	Rack Handling Adapter
RID	Rack Insertion Device
RPC	Remote Power Controller
RPCS	Remote Power Controllers
RSC	Rack Shipping Container
RT	Remote Terminal
SAR	Shared Accommodations Rack
SEE	Single Event Effect
SI	International System of Units
SSC	Station Support Computer
SSP	Space Station/Shuttle Program
SSPC	Solid State Power Controller
SSQ	Space Station Qualified
SUP	Standard Utility Panel
TBC	To Be Confirmed
TBE	Teledyne Brown Engineering
TBD	To Be Determined
TCS	Thermal Control System
UIP	Utility Interface Panel
UOP	Utility Outlet Panel
USL	United States Laboratory
VES	Vacuum Exhaust System
VRS	Vacuum Resource System
VTR	Video Tape Recorder
VVS	Vacuum Vent System
WGS	Waste Gas System

APPENDIX B
GLOSSARY OF TERMS

Access Port: Hole that allows penetration of the Portable Fire Extinguisher nozzle

Active Air Exchange: Forced convection between two volumes. For example, forced convection between a subrack payload and the internal volume of an integrated rack, or forced convection between a subrack payload and the cabin air.

Exception: Uniquely defined for Payloads Processes; refer to Section 5.1 of this document.

Non-Normal: Pertaining to performance of the Electrical Power System outside the nominal design due to ISS system equipment failure, fault clearing, or overload conditions.

Operate: Perform intended design functions given specified conditions.

Rack Maintenance Switch: The switch that controls power to the rack.

Safety-Critical: Having the potential to be hazardous to the safety of hardware, software, and/or personnel.

(This Page Intentionally Left Blank)

APPENDIX C
EXCEPTIONS AND "APPLICABLE WITH NOTES"

C.1 PURPOSE AND SCOPE

The purpose of this appendix is to provide for a repository for PIRN forms prepared as a function of Exceptions to paragraphs of the IRD and/or the ICD Template as well as a listing of those paragraphs identified as Applicable With Notes. Each Payload Unique ICD will include an Appendix containing the data referenced above.

(This Page Intentionally Left Blank)

APPENDIX D
EXCEPTIONS AND OPEN ITEMS

TABLE D–1 TO BE DETERMINED ITEMS
(Page 1 of 2)

TBD No.	Description	Document Section	Page No.	Responsible	Due Date
1	FIR Ground Operations Drawing	3.1.1.1.A	3 – 2	FCF–FIR	FIR CDR –3mos
2	Rack Mass and CG	3.1.1.2.B	3 – 5	FCF–FIR	FIR CDR –3mos
3	Rack Max. Rotation Angle	3.1.1.3.B	3 – 5	FCF–FIR	FIR CDR –2mos
4	PFE Access Port, RMS, Smoke Indic. LED, and C&W Label Locations	3.1.1.3.C	3 – 8	FCF–Common	CIR CDR –3mos
5	Rack to Rack Umbilical Design	3.1.1.3.1	3 – 9	FCF–Common	CIR CDR –3mos
6	FIR Overload Protection Characteristics	3.2.6	3 – 24	FCF–Common	CIR CDR –3mos
7	FIR Power Characteristics	3.2.7	3 – 27	FCF–Common	CIR CDR –3mos
8	FIR Surge Current	3.2.7	3 – 28	FCF–Common	CIR CDR –3mos
9	Elec. Schem. of CIR or EPCE IF to UIP	3.2.7	3 – 29	FCF–FIR	FIR CDR –3mos
10	LRDL Stub Length	3.3.2.1	3 – 31	FCF–FIR	3/02
11	MRDL Cable Length	3.3.3.2	3 – 37	FCF–FIR	3/02
12	Rack Fiber Optic Signal Power	3.3.4.2	3 – 38	FCF–FIR	3/02
13	Rack Air Flow Threshold Voltage	3.3.5.2	3 – 42	FCF–FIR	3/02
14	Fan and Smoke Indic. LED Circuit	3.3.5.2	3 – 42	FCF–Common	CIR CDR –3mos
15	Integrated Rack Air Inclusion	3.5.1.7	3 – 50	FCF–FIR	7/01
16	Cabin Air Sensible Heat Load	3.5.1.8	3 – 50	FCF–FIR	FIR CDR –3mos
17	Cabin Air Latent Heat Load	3.5.1.8	3 – 51	FCF–FIR	FIR CDR –3mos
18	Air Heat Load	3.5.1.9	3 – 51	FCF–FIR	FIR CDR –3mos
19	Exhaust Gas Contingency Events	3.6.1.1	3 – 51	FCF–FIR	FIR CDR +6mos
20	FIR Vented Gases	3.6.1.1	3 – 51	FCF–FIR	FIR CDR –3mos
21	Incompatible Gases	3.6.1.2	3 – 53	FCF–FIR	FIR CDR –3mos
22	Fluid System Servicer Use	3.8.2	3 – 56	FCF–Common	CIR CDR –2 mos
23	Quasi–Steady Disturbances	3.9.1.1	3 – 56	FCF–FIR	7/02

TABLE D–1 TO BE DETERMINED ITEMS

(Page 2 of 2)

TBD No.	Description	Document Section	Page No.	Responsible	Due Date
24	Vibratory Disturbances	3.9.1.2	3 – 57	FCF–FIR	7/02
25	FIR Transient Disturbances	3.9.1.3	3 – 57	FCF–FIR	7/02
26	Continuous Noise Limits	3.9.2.1	3 – 58	FCF–FIR	7/02
27	Intermittent Noise Limits	3.9.2.2	3 – 59	FCF–FIR	7/02